11. WASTE AREA GROUP 9 (MATERIALS AND FUELS COMPLEX)

The Materials and Fuels Complex (MFC)—formerly Argonne National Laboratory-West (ANL-W)—was established in the 1950s to research and develop nuclear reactors and fuel. Since then, three reactors have been constructed at the MFC: the Transient Reactor Test Facility, the Experimental Breeder Reactor (EBR)-II, and the Zero Power Physics Reactor. None of these reactors is currently operating, but past operations and support activities have resulted in chemical and radioactive contamination.

To facilitate cleanup of the contamination, the MFC was designated as Waste Area Group (WAG) 9 under a federal facilities agreement and consent order (FFA/CO) (DOE-ID 1991). To ascertain the extent of this contamination, a comprehensive remedial investigation/feasibility study (RI/FS) was completed in October 1997. Thirty-seven sites, collectively designated as Operable Unit (OU) 9-04, were evaluated during the RI/FS. Five of the sites were found to pose unacceptable risks to human health and/or the environment. This Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC §9601 et seq.) remedial action is proceeding in accordance with the OU 9-04 record of decision (ROD) (DOE, IDEQ, and EPA 1998).

In order to effectively quantify the risks, two of the identified sites were subdivided into smaller areas because of the significantly different exposure pathways. The two sites that were subdivided are (1) the industrial waste pond and associated ditches, which were divided into three areas (industrial waste pond, Ditch A, and Ditch B) and (2) the interceptor canal, which was divided into two areas (canal and mound). Thus, a total of eight areas were identified in the OU 9-04 ROD as requiring remedial action.

Of the eight areas requiring remedial action, two posed unacceptable risks to humans, one posed unacceptable risks to humans and ecological receptors, and the remaining five posed unacceptable risks to ecological receptors only. The three sites that contained Cs-137 were the only MFC sites that posed a risk to human heath, and the sites that contained various inorganics posed unacceptable risks to the ecological receptors. Table 11-1 lists the MFC release sites that required remediation, the contaminants of concern (COCs) at each site, and the cleanup goals for each site. Figure 11-1 shows the locations of the release sites at WAG 9 that required remediation. Risks from the remaining 32 sites were considered acceptable, so they required no further action.

Table 11-2 provides a chronology of significant events at WAG 9.

11.1 Remedial Actions

The following subsections describe the nature of, extent of, and remedial actions for the contamination at the eight CERCLA areas. These eight CERCLA areas pose unacceptable risks to human health and/or the environment. The eight areas were identified as containing hazardous substances that, if not addressed by actions identified in the ROD, might endanger the public and/or environment.

11.1.1 Remedy Selection

The ROD (DOE, IDEQ, and EPA 1998) identified phytoremediation as the selected remedy for OU 9-04 and identified excavation and disposal as the contingent remedy. An explanation of significant difference (ESD) (ANL-W 2000) issued in February 2000 implemented the contingent remedy of excavation and disposal for two areas: Ditch B and the east portion of the main cooling tower blowdown ditch. Another ESD (DOE, IDEQ, and EPA 2004) issued in 2004 implemented the contingent remedy of

Table 11-1. COCs at OU 9-04.

Site Code	Area	COC	95% Upper Confidence Level Concentration	Remediation Goal
ANL-01	Industrial waste pond	Chromium-III	1,030	50
		Mercury	2.62	0.74
		Selenium	8.41	3.4
		Zinc	5,012	2,200
		Cs-137	29.2	23.3
	Ditch A	Mercury	3.94	0.74
	Ditch B	Chromium	1,306	50
		Zinc	3,020	2,200
ANL-01A	Main cooling tower blowdown ditch	Chromium	709	50
		Mercury	8.83	0.74
ANL-04	Sewage lagoons	Mercury	3.2	0.74
ANL-09	Interceptor canal-canal	Cs-137	30.53	23.3
	Interceptor canal-mound	Cs-137	18	23.3
ANL-35	Industrial waste lift station discharge ditch	Silver	352	112

Table 11-2. Chronology of the WAG 9 events.

Event	Date
The consent order and compliance agreement (EPA 1987) was signed.	July 28, 1986
The FFA/CO (DOE-ID 1991) for the Idaho National Laboratory Site was signed.	December 9, 1991
The *Comprehensive Remedial Investigation/Feasibility Study for the Argonne National Laboratory-West Operable Unit 9-04 at the Idaho National Engineering and Environmental Laboratory* (Lee et al. 1997) was completed.	December 1997
The *Final Record of Decision Argonne National Laboratory-West, Operable Unit 9-04* (DOE, IDEQ, and EPA 1998) was completed.	September 29, 1998
Bench-scale phytoremediation testing was completed.	February 1999
The final *Remedial Design/Remedial Action Work Plan for the Argonne National Laboratory-West, Operable Unit 9-04* was completed.	August 1999
Implementation of phytoremediation began at four sites.	May 17, 1999
The *Explanation of Significant Differences to the Record of Decision for Argonne National Laboratory-West Operable Unit 9-04* (ANL-W 2000) to implement the contingent remedy of excavation and disposal at the Central Facilities Area landfill.	February 2000
The *Phytoremediation 2-Year Field Season Demonstration Project Report, Argonne National Laboratory-West* (ANL-W 2001) was submitted to the regulatory agencies.	March 2001
The *Sampling and Analysis Plan for the Post-Phytoremediation Characterization of ANL-W CERCLA Sites* (Portage 2003) was submitted to the regulatory agencies.	July 2003

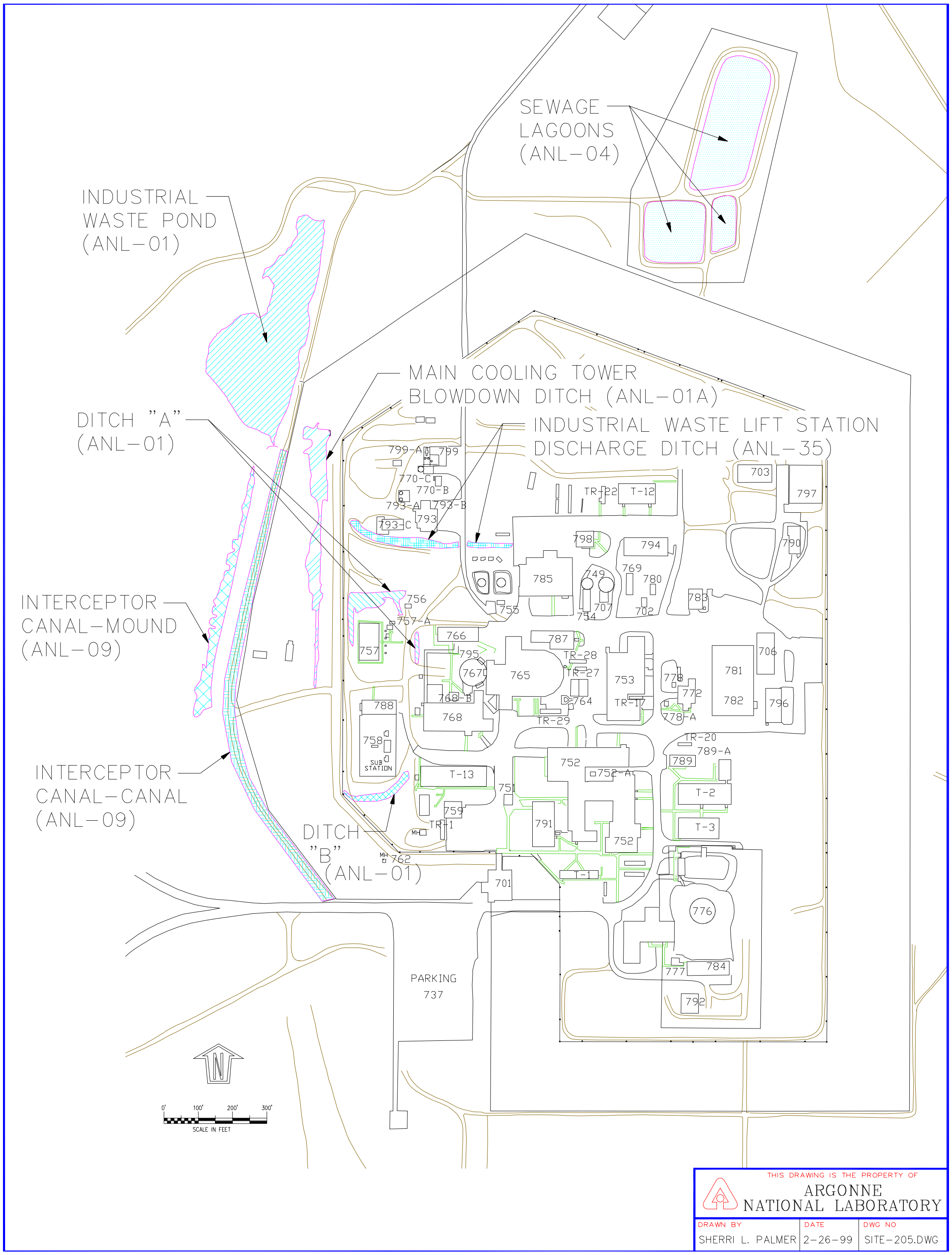

Figure 11-1. MFC areas that required remediation.

excavation and disposal for the industrial waste pond and hot spot removal in Ditch A and the industrial waste lift station discharge ditch. The one remaining area not yet undergoing remediation is the ANL-04 sanitary sewage lagoons. The remediation of that area is not scheduled to occur until its useful life is completed. Currently, the sanitary sewage lagoons are anticipated to remain in use until 2033.

11.1.2 Remedial Action Objectives

Remedial action objectives (RAOs) for the eight areas of concern were developed in accordance with 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," and CERCLA RI/FS guidance through meetings with the Idaho Department of Environmental Quality, the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Energy (DOE). The RAOs result from risk assessments and are specific to the COCs and exposure pathways developed for OU 9-04.

The RAO for protection of human health and safety is to inhibit direct exposure to radionuclide COCs in soil that would result in a total excess cancer risk of greater than 1 in 10,000 to 1,000,000 (1E-04 to 1E-06) to current and future workers and future residents.

The RAO for protection of the environment is to prevent exposure to COCs in soils that may have potential adverse effects to resident populations of flora and fauna, as determined by a hazard quotient equal to 10 times the hazard quotient calculated from Idaho National Laboratory (INL) Site background soil concentrations.

To meet these RAOs, preliminary remediation goals were established. The goals are quantitative cleanup levels based primarily on applicable or relevant and appropriate requirements and risk-based doses. Final remediation goals are based on the results of the baseline risk assessment and an evaluation of expected exposures and risks for selected alternatives. Table 11-1 presents the final remediation goals. Remedial actions were completed to ensure that risk would be mitigated and exposure would not exceed the final remediation goals.

11.1.3 Remedy Implementation

The following subsections describe the remedial actions implemented at the OU 9-04 sites. A full description of the remedial actions can be found in the two remedial design work plans for OU 9-04 (ANL-W 1999, 2004). In 1999, the first remedial design work plan document implemented phytoremediation on four areas and excavation and disposal of Ditch B and the east portion of the main cooling tower blowdown ditch. The 2004 remedial design work plan implemented excavation and disposal of the industrial waste pond and hot spot removal of soil in two previously phytoremediated sites (Ditch A and the industrial waste lift station discharge ditch).

11.1.3.1 Industrial Waste Pond (Site ANL-01). The industrial waste pond sediments contained low levels of Cs-137 that pose unacceptable risks to humans. The pond sediments also contained four inorganics (i.e., chromium, mercury, selenium, and zinc) that posed unacceptable risks to ecological receptors. In 2004, the decision was made to implement the contingent remedy of excavation and disposal rather than phytoremediation at this site because of potential future projects at MFC. The excavation and disposal activities were completed in 2004, with the soil being transported to the Idaho CERCLA Disposal Facility (ICDF). A total of 1,351 tons of soil was removed during the first campaign, and confirmation sampling indicated one hot spot remained for chromium that exceeded the remediation goal. Consequently, a second campaign of excavation and disposal was conducted in November 2004 and removed all of the soil from this hot spot down to the basalt. The hot spot removal resulted in 136 tons of soil that was transported to the ICDF in November 2004. The shipments of waste to the ICDF were tracked using Waste Profile 4243P in the Integrated Waste Tracking System (IWTS).

Tables 20 and 24 of the *Data Quality Assessment Report for the Post-Remedial Action Confirmation Sampling of the ANL-W CERCLA Sites* (Portage 2005a) show the statistical calculation of each COC for the surface and subsurface soils, respectively. After remediation, each of the five contaminants were below the established remediation goals for the surface and subsurface data sets, with the exception of chromium in the surface soils. The chromium in the surface soils had a mean concentration of 433 mg/kg and calculated upper confidence limit (UCL) of 626 mg/kg, which exceeded the 500-mg/kg remediation goal. However, the State of Idaho and EPA agreed that since the pond will continue to be used as a pond, no vegetation (bunch grass) could grow underwater; thus, no pathway exists.

11.1.3.2 Ditch A (Site ANL-01). In May 1999, phytoremediation actions were initiated at Ditch A, which contained mercury contamination that posed an unacceptable risk to ecological receptors. Phytoremediation was estimated to take seven years to meet the remediation goal of 0.74 mg/kg for mercury. Preliminary results from a two-field season showed that phytoremediation with hybrid willows and poplars was working better than expected and that remediation goals could be met after four years rather than the estimated seven years.

Phytoremediation activities continued in 2001 and 2002, and confirmation samples were collected in 2003 and summarized in the *Data Quality Assessment Report for Post-Phytoremediation Characterization of ANL-W CERCLA Sites* (Portage 2005b). The sampling results indicated that hot spots remained, so the decision was made to implement the contingent remedy of excavation and disposal in 2004. The excavation and disposal activities were also completed in 2004, with the excavated soil being transported to the Central Facilities Area (CFA) bulky waste landfill and placed at a depth greater than 10 ft to prevent exposure to ecological receptors. The 50 yd^3 of waste was tracked using Waste Profile 4428P in IWTS.

Tables 13 and 16 of the *Data Quality Assessment Report for the Post-Remedial Action Confirmation Sampling of the ANL-W CERCLA Sites* (Portage 2005a) show the statistical calculation of mercury for the surface and subsurface soils, respectively. The UCL values in the surface and subsurface soils were 0.64 mg/kg and 0.74 mg/kg, respectively, which are at or below the mercury remediation goal of 0.74 mg/kg.

11.1.3.3 Ditch B (Site ANL-01). An ESD (ANL-W 2000) issued in February 2000 implemented the contingent remedy of excavation and disposal of the soil, rather than phytoremediation, at Ditch B. The excavation activities were conducted in June 2000 using front-end loaders and backhoes to remove the soil from the ditch down to the top of the basalt. Dump trucks moved the soil to the staging area. The soil was stockpiled near the ditch and covered with plastic material to prevent the spread of contamination from windblown dust, rainfall, and leachate. The soil remained at the stockpiled area until the soil could be accepted at a new waste cell in the CFA landfill. The soil was deposited in the bottom of the cell at a depth greater than 10 ft to prevent exposure to ecological receptors. Confirmation samples could not be collected because all the soil was removed. The 30 yd^3 of waste was tracked using Waste Profile 2550P in IWTS.

11.1.3.4 Main Cooling Tower Blowdown Ditch (Site ANL-01A). Remediation activities for this site were initiated in May 1999. The main cooling tower blowdown ditch was divided into two portions based on location. The east portion of the ditch is located near the cooling tower inside the MFC protection area. The west portion of the ditch is located between the inner and outer security fences. Contaminant concentrations for the soil in these two portions varied by orders of magnitude, and the selected remedy of phytoremediation would only work on the west portion. The east portion received the cooling tower discharge and had the highest contaminant concentrations, and the west portion had much lower concentrations and conveyed the effluent to the industrial waste pond. Because of the concentration differences between these two portions of the same CERCLA site, the decision was made to use excavation and disposal on the east portion and phytoremediation on the west portion.

The east portion of the main cooling tower blowdown ditch lies within the MFC security protection area and was the receiving location for water discharged from the cooling tower. For that portion of the ditch, the contingent remedy of excavation and disposal of the soils, rather than phytoremediation, was implemented per an ESD issued in February 2000 (ANL-W 2000). The excavation activities were conducted in May 2000 using front-end loaders and backhoes to remove soil from the ditch down to a depth of 2 ft. The soil was stockpiled with the Ditch B soil and covered with plastic material to the prevent spread of contamination from windblown dust, rainfall, and leachate. Soil samples indicated that the remediation goals had not been achieved, and additional soil was removed to basalt (approximately 6 ft) in June 2000. The 130 yd^3 of stockpiled soil was disposed of at the CFA landfill in July using IWTS Profile 2550P. The soil was placed in the bottom of the CFA landfill cell at a depth greater than 10 ft to prevent exposure to ecological receptors. Confirmation sampling results were not collected, because no soil existed above basalt and the ditch was backfilled with clean soil to grade.

Phytoremediation actions were initiated at the west portion of the main cooling tower blowdown ditch in May 1999. Initial activities included removal of soil from the area inside the two security fences and placing the soil inside the MFC controlled area. That action was necessary, because trees growing in the security area could have potentially provided concealment of threats to MFC. Phytoremediation was estimated to take seven years to meet the remediation goals of 500 mg/kg and 0.74 mg/kg for chromium and mercury, respectively. The results after the first two years of implementation showed that phytoremediation using the hybrid willows and poplars was working better than expected and remediation goals could be met after four years rather than the estimated seven years. Phytoremediation activities continued in 2001 and 2002, and confirmation samples were collected in 2003. Tables 5 and 9 of the *Data Quality Assessment Report for the Post-Phytoremediation Characterization of ANL-W CERCLA Sites* (Portage 2005b) show the UCL values for chromium and mercury in the surface and subsurface soils, respectively. The UCLs for surface samples and subsurface for chromium were 54.8 mg/kg and 61 mg/kg, respectively, well below the remediation goal of 500 mg/kg. The UCL for mercury in the surface and subsurface was 0.42 mg/kg and 0.37 mg/kg, respectively, both below the remediation goal of 0.74 mg/kg.

11.1.3.5 Sanitary Sewage Lagoons (Site ANL-04). The sanitary sewage lagoons contain mercury that poses an unacceptable risk to the ecological receptors. The OU 9-04 ROD (DOE, IDEQ, and EPA 1998) delayed remediation of the sanitary sewage lagoons until the end of the useful life of the lagoons, which was anticipated to be in 2033. The selected remedy in the OU 9-04 RI/FS was phytoremediation with the contingent remedy of excavation and disposal.

Because the sanitary sewage lagoons will continue to be flooded by wastewaters in the foreseeable future, it is unlikely that the ecological receptor identified in the OU 09-04 ROD (i.e., Merriams shrew) will interact with the contaminated soil present in the bottom of the lagoons.

11.1.3.6 Interceptor Canal-Mound (Site ANL-09). Phytoremediation actions were initiated at the interceptor canal-mound in May 1999. Phytoremediation was estimated to take seven years to meet the remediation goal of 23.3 pCi/g. Results documented in the *Phytoremediation 2-Year Field Season Demonstration Project Report, Argonne National Laboratory-West* (ANL-W 2001) showed that phytoremediation using an annual planting of 750,000 kochia scoparia plants was working better than expected and that remediation goals could be met after four years rather than the estimated seven years. The phytoremediation activities were again initiated for the 2001 and 2002 field seasons. After each field season, plant matter was collected, compacted, sampled, and placed into waste boxes. After four years of phytoremediation, the 10.6 yd^3 of waste was transported to the Radioactive Waste Management Complex for disposal as low-level waste using IWTS Profile 2334P. Sample results of soil taken in 2003 indicate that the Cs-137 concentration was below the established remediation goal. Tables 14 and 18 of the *Data Quality Assessment Report of the Post-Phytoremediation Characterization of ANL-W CERCLA Sites* (Portage 2005b) compare the surface and subsurface soils to the remediation goal. The UCLs for the surface and subsurface Cs-137 were 9.54 pCi/g and 2.48 pCi/g, respectively, well below the 23.3 pCi/g remediation goal. However, because the Cs-137 concentrations were greater than those that are acceptable for the occupations receptors, the site will remain under institutional controls until the levels decay to 2.3 pCi/g.

11.1.3.7 Interceptor Canal-Canal (Site ANL-09). The interceptor canal-canal contains low levels of Cs-137 that pose unacceptable risks to humans for the occupational receptor scenario. The concentration of Cs-137 was found to be 18 pCi/g, which is below the established remediation goal for free release of 23.3 pCi/g. This site will remain under institutional controls. The Cs-137 contamination will decay to background levels in 2085. Thus, this site requires no remediation other than institutional controls and to continue completion of the five-year reviews.

11.1.3.8 Industrial Waste Lift Station Discharge Ditch (Site ANL-35). Phytoremediation actions were initiated at the industrial waste lift station discharge ditch in May 1999. This site was remediated because of silver contamination that posed unacceptable risks to the ecological receptors. Initially, phytoremediation was estimated to take seven years to meet the remediation goal of 112 mg/kg. Results of the *Phytoremediation 2-Year Field Season Demonstration Project Report* (ANL-W 2001) showed that phytoremediation with hybrid willows and poplars was working better than expected and remediation goals could be met after four years. Phytoremediation activities continued for the 2001 and 2002 field seasons, with confirmation samples collected in 2003. Tables 22 and 26 of the *Data Quality Assessment Report for the Post-Phytoremediation Characterization of ANL-W CERCLA Sites, Argonne National Laboratory-West* (Portage 2005b) show the surface and subsurface UCLs and remediation goal for silver. As shown, the UCL of 104 mg/kg for silver in the surface and 55.4 mg/kg for silver in the subsurface are below the remediation goal of 112 mg/kg. However, data indicated that a hot spot near the surface contributed significantly to the statistics and additional remediation was warranted.

As such, the decision was made to implement the contingent remedy of excavation and disposal in the 2004 ESD (DOE, IDEQ, and EPA 2004). The excavation and disposal activities were conducted in the summer of 2004. Tables 5 and 9 of the *Data Quality Assessment Report for the Post-Remedial Action Confirmation sampling of the ANL-W CERCLA Sites* (Portage 2005a) show that the UCL for silver in the surface was 191 mg/kg and the UCL for silver in the subsurface was 32.3 mg/kg, while the remediation goal was 112 mg/kg. Thus, the surface soil exceeded the remediation goal, and further excavation was warranted.

Consequently, in October 2004, the area with highest silver results was excavated to basalt. Approximately 100 yd^3 of soil from the excavation events in 2004 was shipped and disposed of at the CFA bulk waste landfill. That soil was placed at a depth greater than 10 ft to prevent exposure to ecological receptors. Confirmation samples were not collected after the removal, because all soil in the targeted area was removed to basalt.

11.2 Data Evaluation

The OU 9-04 ROD (DOE, IDEQ, and EPA 1998) stated that monitoring of the soil, groundwater, and vegetation will continue until 2018. Results from the sampling are submitted annually to the DOE contractor for incorporation into the INL annual site report. The most recent annual monitoring report is for calendar year 2003 and can be found at http://www.stoller-eser.com/annuals/2003. Review of these results indicates that soil or vegetation results have not increased from those levels recorded in 1998 and are well below the levels defined as hazardous waste.

The MFC groundwater monitoring program consists of one upgradient well and three downgradient wells. In addition, one production well is sampled from within the MFC security area. All wells are sampled twice annually—typically in April and October. Review of the groundwater data indicates that 22 occurrences were above the drinking water maximum contaminant levels (DWMCLs) from 1998 through 2004. The data for the 22 occurrences are shown in Table 11-3. The results for upgradient monitoring well (ANL-MON-A-012) showed aluminum and thallium above the DWMCLs; aluminum, thallium, iron, sodium, lead, and nitrate were detected in the downgradient wells. None of these contaminants were COCs for the CERCLA sites. These data do not show a consistent pattern of increased trends and appear to be sampling anomalies. The one exception, however, is the sodium in ANL-MON-A-013, in which the sodium levels stay slightly above the MCL. Sodium, considered a secondary DWMCL, can cause problems for some individuals, but no receptor is currently drinking that water. ANL-MON-A-013 is used to monitor the industrial waste pond, and elevated levels of sodium are expected.

Table 11-3. MFC groundwater values exceeding DWMCLs.

Well Location	Analyte	Value in (mg/L)	DWMCLs (mg/L)	Sample Date	Sample Number	Laboratory Qualifiers[a]
ANL-MON-A-011	Iron	3.63	0.3	03/23/1999	AGW07501-C4/MW-11	
ANL-MON-A-011	Iron	0.618	0.3	08/7/2001	ANL-206-01C4	
ANL-MON-A-011	Thallium	0.0043	0.002	05/9/2002	ANL-104-02-C4	B
ANL-MON-A-012	Aluminum	0.0568	0.05	03/22/1999	AGW07601-C4/MW-12	B
ANL-MON-A-012	Aluminum	0.182	0.05	04/23/2001	ANL-006-01C4	B
ANL-MON-A-012	Thallium	0.0043	0.002	05/8/2002	ANL-072-02-C4	B
ANL-MON-A-012	Thallium	17.9	0.002	04/21/2003	ANL-008-03	B
ANL-MON-A-013	Sodium	21.9	20	10/12/1999	MW-13	
ANL-MON-A-013	Sodium	21.3	20	06/27/2000	ANL-102-00C4	
ANL-MON-A-013	Sodium	21.3	20	10/9/2000	ANL-217-00C4	
ANL-MON-A-013	Sodium	20.4	20	04/23/2001	ANL-020-01C4	
ANL-MON-A-013	Iron	0.479	0.3	10/7/2003	ANL-188-03	
ANL-MON-A-013	Aluminum	0.0893	0.05	04/20/2004	07604	
ANL-MON-A-013	Iron	0.363	0.3	04/20/2004	07604	
ANL-MON-A-014	Lead	0.0162	0.015	01/29/1997	AGW03501C4	S
ANL-MON-A-014	Nitrate	137	10	01/29/1997	AGW03501ND	
ANL-MON-A-014	Iron	0.69	0.3	03/23/1999	AGW07801-C4/MW-14	
ANL-MON-A-014	Thallium	0.0031	0.002	10/12/1999	MW-14	
ANL-MON-A-014	Aluminum	0.0751	0.05	10/16/2000	ANL-244-00C4	B
ANL-MON-A-014	Iron	0.375	0.3	05/8/2002	ANL-115-02-C4	
ANL-MON-A-014	Thallium	0.0034	0.002	05/8/2002	ANL-115-02-C4	B
EBR-II #2	Aluminum	0.0975	0.05	04/25/2001	ANL-051-01C4	B

a. The B-reported value was obtained from a reading that was less than contract-required detection limit but greater than the instrument detection limit. The S-reported value was determined by the method of standard additions.

The groundwater level in the one upgradient and three downgradient wells has dropped approximately 12 ft since 1998. This drop has caused significant problems in the collection of samples. In May 2002, water samples could not be collected from Well M-12, because the inlet to the pump was above the water table. In the October 2002, Wells M-11 and M-12 could not be sampled because of a continued drop in the water table. As a result, all of the pumps for the four monitoring wells were lowered to within 1 ft of the bottom. In April 2004, water samples could not be collected from Well M-11, because the water dropped below the pump inlet. This well was redrilled and lowered 50 ft. Continued drought and upgradient use of the groundwater by irrigators are being blamed on the drop in the water table below MFC. If the trend continues, Well M-13 will have to be redrilled and the pump lowered in order for water samples to be collected.

11.3 Progress since Last Review

This is the first five-year review of OU 9-04.

11.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

The functional status of the remedy for each of the OU 9-04 areas is provided in Table 11-4. For seven areas, the remedial action is complete, with the final signatures on the remedial action report pending. For three of these areas, continued institutional controls are required because of remaining concentrations of Cs-137. The institutional controls to prevent inadvertent access to these three areas have been implemented and are functioning as originally intended. At the three sites that contain Cs-137, institutional controls will continue until the levels reach the INL Site background of 2.3 pCi/g. Table 11-4 summarizes the responses to the functionality of the OU 9-04 remedies as of September 2004.

Table 11-4. Summary of responses to Question A.

Site	Area	Remedy	Remedial Action Complete	Remedy Functioning (as documented in remedial action report)
ANL-01	Industrial waste pond	Soil excavation	YES – 2004, except for remedial action report	Pending (only institutional controls required)
	Ditch A	Phytoremediation then soil excavation	Yes – 2004, except for remedial action report	Pending
	Ditch B	Soil excavation	Yes – 2004, except for remedial action report	Pending
ANL-01A		Phytoremediation	Yes – 2004, except for remedial action report	Pending
ANL-04	Sewage lagoons	Phytoremediation with contingent excavation and disposal	No – In 2005 this site is being moved to OU 10-08	Not applicable (transferred to OU 10-08)
ANL-09	Interceptor canal-canal	Phytoremediation	Yes – 2004, except for remedial action report	Pending (only institutional controls required)
ANL-35	Interceptor canal-mound	Natural attenuation	Yes – 2004	Pending (only institutional controls required)
	Industrial waste lift station discharge ditch	Phytoremediation then soil excavation	Yes – 2004, except for remedial action report	Pending

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?*

Of the toxicological criteria for COCs at OU 9-04, none has undergone any major revisions or updates that would decrease the final remediation goals. Therefore, once met, the final remediation goals (site-specific, risk-based cleanup levels) will remain protective of human health and the environment under current exposure scenarios. Monitoring results show that the contaminant concentrations are well below the established final remediation goals.

The original assumptions, cleanup levels, and RAOs used at the time of the remedy selection are still valid. Successful implementation of the phytoremediation and/or excavation and disposal remedies has reduced the concentrations of Cs-137 and inorganic contaminants to levels that are acceptable to humans and the ecological receptors.

Question C: *Has any other information come to light that could call into question the protectiveness of the remedy?*

No.

11.5 Technical Assessment Summary

Remedial actions have been completed in accordance with the decision documents at Sites ANL-01, -01A, -09, and -35. Based on the available data, the remedial actions at the sites were completed successfully and the remedies are functioning as intended. The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selections are still valid, and no new information has come to light that could call into question the protectiveness of the remedies. In addition to the remediation of these sites, institutional controls have been implemented at the industrial waste pond (ANL-01) and at both areas within ANL-09 (interceptor canal-canal and interceptor canal-mound) and are functioning as required.

11.6 Issues

No issues have been identified during the ongoing OU 9-04 remedial action activities that have not been resolved through the two ESDs (ANL-W 2000; DOE, IDEQ, and EPA 2004a).

11.7 Recommendations and Follow-up Actions

As discussed in the OU 9-04 ROD, remedial actions for the sanitary lagoons (ANL-04) were delayed until the end of their useful lives. However, because the mission of MFC has changed, the sewage lagoons are scheduled to receive discharge until approximately 2033 in support of continued activities at the MFC. Because remedial actions have been completed at all of the CERCLA sites at WAG 9, it is recommended that the ANL-04 be transferred to OU 10-08, thus allowing the closure of WAG 9.

11.8 Protectiveness Statement

Remedial actions have been completed at seven of the eight areas identified in the 9-04 ROD (DOE, IDEQ, and EPA 1998). These seven areas are awaiting final regulatory approval of the remedial action report (Portage 2005c). The remaining area that has not undergone remediation activities is the sanitary sewage lagoon site, which is being transferred to OU 10-08. This five-year review is being used to officially document the transfer of the sanitary sewage lagoons to OU 10-08, as discussed in Ceto (2005) and Faulk (2005). The remedies on the remaining areas at OU 9-04 are protective of human health and the environment.

11.9 Section 11 References

40 CFR 300, 2003, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*, Office of the Federal Register, July 2003.

42 USC 9601 et seq., 1980, "Comprehensive Environmental Response Compensation and Liability Act of 1980," as amended, *United States Code*.

ANL-W, 1999, *Final Remedial Design/Remedial Action Work Plan for the Argonne National Laboratory-West*, Idaho National Engineering and Environmental Laboratory, August 1999.

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12. WASTE AREA GROUP 10 (SITEWIDE AREA)

Waste Area Group (WAG) 10 comprises miscellaneous surface sites and liquid disposal areas throughout the Idaho National Laboratory (INL) Site that are not included within other WAGs (WAGs 1 through 9). WAG 10 also includes INL Site-related concerns about the Snake River Plain Aquifer (SRPA) that cannot be addressed on a WAG-specific basis.

The scope of WAG 10 was expanded from the original federal facility agreement and consent order (FFA/CO) concept (DOE-ID 1991). Several new sites have been identified and a facility assessment has been completed since the initial signing of the INL Site FFA/CO, as discussed in the *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001). Other changes in scope have resulted in the creation of Operable Unit (OU) 10-08 within WAG 10 to evaluate INL Site groundwater concerns. The WAG 6 comprehensive remedial investigation/feasibility study (RI/FS) (OU 6-05) was incorporated into OU 10-04 in accordance with the FFA/CO (DOE-ID 1991).

The FFA/CO originally identified 42 release sites under WAG 10, which were separated into one no-action OU (called “OU none”) and five action OUs (10-01 through 10-05). Since the initial preparation of the FFA/CO, however, additional sites and three OUs (10-06 through 10-08) have been added to WAG 10.

OU 10-01 contained two disposal pits, the Liquid Corrosive Chemical Disposal Area (LCCDA)-01, which operated between 1960 and about 1971, and LCCDA-02, which operated from about 1970 until the area was closed in 1981 (EG&G 1986). The LCCDA, which is located approximately 0.6 mi east of the main Radioactive Waste Management Complex (RWMC) entrance, was used to dispose of solid and liquid corrosive chemicals such as nitric acid, sulfuric acid, and sodium hydroxide. Sites LCCDA-01 and -02 were retained for evaluation in the OU 10-04 comprehensive RI/FS because of uncertainties attributed to the limited number of samples collected for the Track 2 investigations.

Included in OU 10-02 was the Organic-Moderated Reactor Experiment (OMRE) leach pond, which was used for wastewater disposal from the OMRE reactor. The reactor operated between 1957 and 1963 in the southern portion of the INL Site, approximately 2 mi east of the Central Facilities Area (CFA). Between one million and two million gallons of radioactive wastewater, possibly contaminated with organic coolant and decomposition waste, are estimated to have been discharged to the pond, where the water either evaporated or infiltrated into the ground. The leach pond area underwent decontamination and decommissioning in 1978, when it was remediated by excavating the more contaminated soil and then filling the pond with clean soil. The site was retained for further evaluation under the OU 10-04 comprehensive RI/FS.

The ordnance areas at the INL Site were addressed in OU 10-03 and included 29 areas (including the Naval Ordnance Disposal Area [NODA]) that contained ordnance or explosives-contaminated soil. Walk-downs of the ordnance sites occurred from 1993 through 1997 and in 2000 in search of unexploded ordnance (UXO). An interim action commenced in 1993 to address six of the ordnance areas originally identified under OU 10-03 and designated as OU 10-05. Twenty-seven of the 29 ordnance areas were retained for evaluation under the OU 10-04 comprehensive RI/FS.

OU 10-04 includes the SRPA and two sites identified at the Security Training Facility (STF), including the STF-601 sump and pits and the STF gun range. Although the SRPA was originally part of OU 10-04, it will be evaluated in the OU 10-08 RI/FS. The WAG 10 sites (Figure 12-1) assessed under

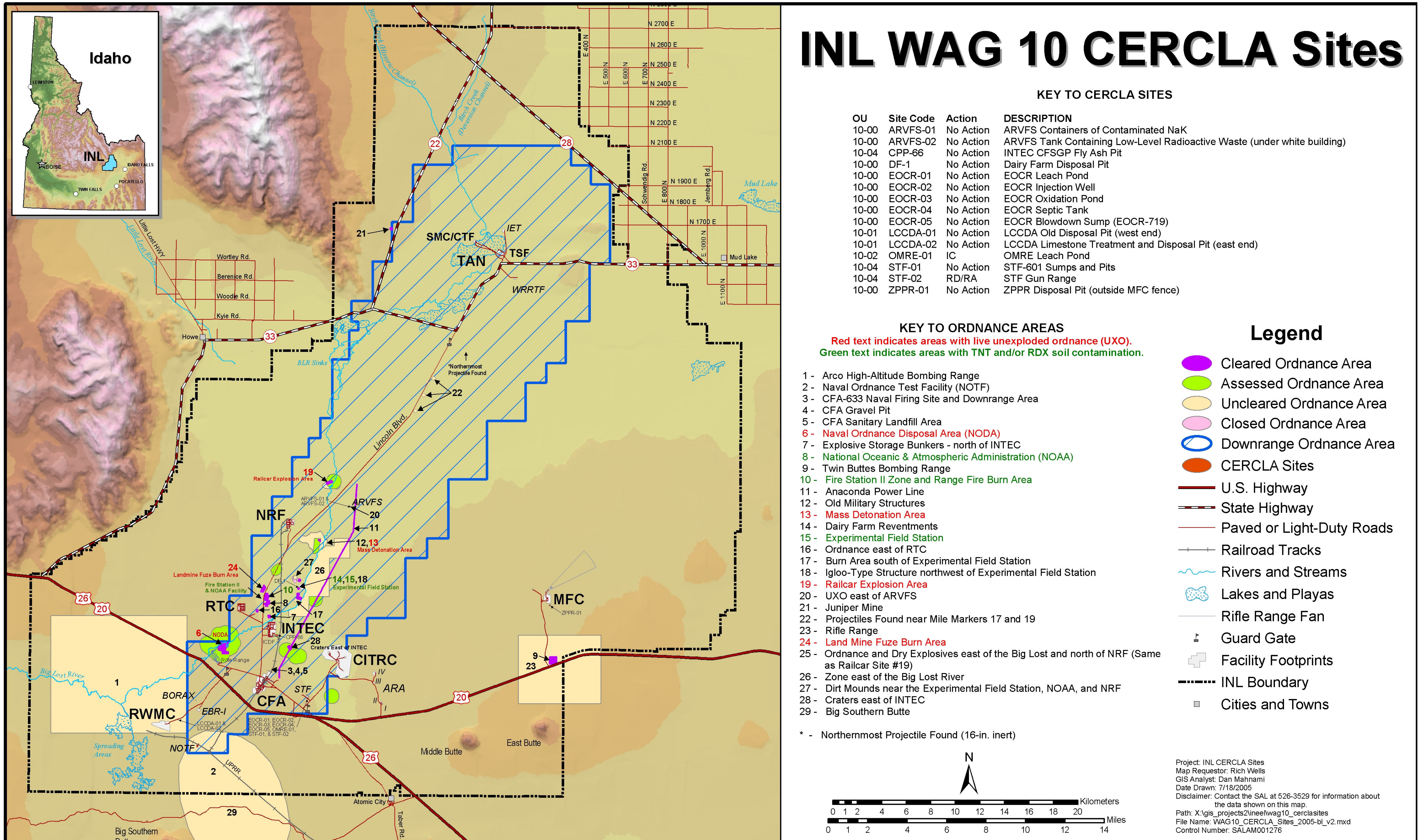

Figure 12-1. WAG 10 Comprehensive Environmental Response, Compensation, and Liability Act sites.

the comprehensive OU 10-04 RI/FS included 27 sites consisting of 10 miscellaneous sites, two sites at the LCCDA, one site at the OMRE, two sites at the STF, three large (primary) ordnance areas (one of that included 16 smaller ordnance areas), nine ordnance areas either outside the boundaries of the larger ordnance areas or containing soil contamination, and the fly ash pit (added to OU 10-04 for an ecological risk assessment). The three primary ordnance areas include the Naval Proving Ground (also know as the Naval Gun Range), the Arco High-Altitude Bombing Range, and the Twin Buttes Bombing Range. Most of the ordnance, UXO, and ordnance-related areas at the INL Site resulted from ordnance testing, demolition of explosives, and bombing practice conducted during the 1940s, when a portion of the INL Site was a naval proving ground.

Table 12-1 lists the contaminants of concern (COCs) and corresponding remediation goals for OU 10-04 sites requiring cleanup. Note that the UXO sites, while requiring remediation for the ordnance, do not have remediation goals listed, because UXO does not pose a hazard to human health and the environment in terms normally considered for sites requiring remediation; instead, the UXO in these areas presents an unacceptable risk of acute physical injury from fire or explosion.

Table 12-1. COCs for OU 10-04.

Site (Site Code)	Contaminant	Concentration	Remediation Goal
STF Gun Range (STF-02)	Lead	Maximum 24,000 mg/kg	400 mg/kg
Arco High-Altitude Bombing Range (ORD-01)	UXO	Not applicable (NA)	NA
Naval Ordnance Disposal Area 2 (ORD-06)	Cyclotrimethylene trinitroamine (RDX)	Maximum 328 mg/kg	4.4 mg/kg
	UXO	NA	NA
National Oceanic and Atmospheric Administration (ORD-08)	1,3-Dinitrobenzene	Maximum 27 mg/kg	6.1 mg/kg
	RDX	95% UCL, 1.78 mg/kg	4.4 mg/kg
	Trinitrotoluene (TNT)	95% UCL, 1,900 mg/kg	16 mg/kg
	UXO	NA	NA
Twin Buttes Bombing Range (ORD-09)	UXO	NA	NA
Fire Station II Zone and Range Fire Burn Area (ORD-10)	RDX	Maximum 3.7 mg/kg	4.4 mg/kg
	TNT	Maximum 130 mg/kg	16 mg/kg
Mass Detonation Area (ORD-13)	UXO	NA	NA
Experimental Field Station (ORD-15)	1,3-Dinitrobenzene	Maximum 14 mg/kg	6.1 mg/kg
	TNT	Maximum 1,100 mg/kg	16 mg/kg
	UXO	NA	NA
Rail Car Explosion Area (ORD-19)	UXO	NA	NA
Land Mine Fuze Burn Area (ORD-24)	TNT	Maximum 79,000 mg/kg	16 mg/kg
	UXO	NA	NA

OU 10-05 was cited in the FFA/CO (DOE-ID 1991) as the "Ordnance Interim Action." The six sites covered by OU 10-05 are a subset of the ordnance sites evaluated under OU 10-03. The sites consisted of the CFA gravel pit, the explosive storage bunkers north of the Idaho Nuclear Technology and Engineering Center (INTEC), the National Oceanic and Atmospheric Administration (NOAA) grid, the CFA-633 naval firing site and downrange area, the Fire Station II zone and range fire burn area, and the Anaconda power line. The *Declaration of the Record of Decision for Ordnance Interim Action Operable Unit 10-05* (DOE-ID 1992) was signed in 1992, and the interim action was completed in 1994, as reported in the *Preliminary Scoping Track 2 Summary Report for Operable Unit 10-03 Ordnance* (DOE-ID 1998).

OU 10-06 was developed to assess radionuclide-contaminated soil areas at several of the WAGs. OU 10-06 also included a non-time-critical removal action to remediate several radionuclide-contaminated soil sites at different WAGs. The "ownership" of the sites outside of WAGs 6 and 10 reverted to the respective WAGs after the OU 10-06 non-time-critical removal action was completed. The residual risk at the two WAG 6 sites that were remediated under OU 10-06, Sites EBR-15 and BORAX-08, were also evaluated in the comprehensive RI/FS for WAGs 6 and 10 (DOE-ID 2001).

OU 10-07 comprises the U.S. West buried telecommunications cable that was installed by the American Telephone and Telegraph Company (AT&T) in the early 1950s. The cable is approximately 36.5 mi long and is buried approximately 3 to 4 ft deep, parallel to and approximately 100 yd east of Lincoln Boulevard at the INL Site. The cable consists of copper wiring, paper insulation, and lead sheathing approximately 1/8 in. thick. It is wrapped in spiraled steel and enclosed in jute wrapping impregnated with an asphalt-like substance. The cable originates at CFA and extends along Lincoln Boulevard to INTEC, the Reactor Technology Complex (RTC, formerly the Test Reactor Area [TRA]), the Naval Reactors Facility (NRF), and Test Area North (TAN). The cable was cut and abandoned by U.S. West in 1990, and a new fiber optic cable was installed.

OU 10-08 includes INL-related concerns about the SRPA that cannot be addressed on a WAG-specific basis. With concurrence by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the Idaho Department of Environmental Quality (DEQ), OU 10-08 also includes new sites discovered at other WAGs after their records of decision (RODs) have been signed and if the site cannot be addressed by an existing remedy. As provided in the *Waste Area Group 10, Operable Unit 10-08 Remedial Investigation/Feasibility Study Work Plan (Final)* (DOE-ID 2002a), the OU 10-08 ROD will be the final decision document to be prepared under the terms of the FFA/CO (DOE-ID 1991). The draft OU 10-08 RI/FS work plan is to be submitted to the EPA and DEQ within 15 months of the signature date for final site-specific ROD (currently the OU 7-13/14 ROD), with the draft OU 10-08 RI/FS to be completed within 24 months of the final site-specific ROD. The current enforceable date for submittal of the draft OU 7-13/14 ROD is December 2007, with signature to follow approximately six months after in order to allow for reviews of the draft and draft final versions of the document.

Table 12-2 provides a chronology of significant events at WAG 10.

Table 12-2. Chronology of WAG 10 events.

Event	Date
The Naval Proving Ground was established.	1942
The testing of guns commenced.	November 20, 1943
The OMRE reactor began operations.	September 17, 1957
The Experimental Organic-Cooled Reactor was placed in standby status (never operated).	December 1962
OMRE operations ceased.	April 1963
The *Declaration of the Record of Decision for Ordnance Interim Action Operable Unit 10-05* (DOE-ID 1992) was completed.	1992
The *Engineering Evaluation/Cost Analysis (EE/CA) for Non-Time-Critical Removal Action at Unexploded Ordnance Locations at the Idaho National Engineering Laboratory (INEL), Operable Unit (OU) 10-03* (INEL 1994a) was completed.	April 1994
The *Remedial Action Report for the Interim Action to Cleanup Unexploded Ordnance Locations at the INEL (Operable Unit 10-05)* (Wyle 1994) was completed.	May 1994
The *Department of Energy Idaho Field Operations Office Lead Agency Action Memorandum for the Non-Time Critical Removal Action at Unexploded Ordnance Locations at the Idaho National Engineering Laboratory (INEL)* (DOE-ID 1994a) was completed.	June 1994
The *Engineering Evaluation/Cost Analysis for a Non-Time Critical Removal Action of TNT- and RDX-Contaminated Soil at the Idaho National Engineering Laboratory* (INEL 1994b) was completed.	June 1994
The *Department of Energy Idaho Operations Office Lead Agency Action Memorandum for the Non-Time Critical Removal Action of TNT- and RDX-Contaminated Soil, Idaho National Engineering Laboratory* (DOE-ID 1994b) was completed.	July 1994
The *Removal Action Report for the Ordnance Removal Action, Operable Unit 10-03* (Wyle 1995a) was completed.	March 1995
The *Addendum to the Removal Action Report for the Ordnance Removal Action, Operable Unit 10-03* (Wyle 1995b) was completed.	October 1995
The *U.S. Department of Energy, Idaho Operations Office Lead Agency Action Memorandum Time-Critical Removal Action Ordnance Areas Operable Unit 10-03 Idaho National Engineering Laboratory (INEL)* (DOE-ID 1996) was completed.	September 1996
The *Final Action Report for the Time Critical Removal Action, Operable Unit 10-03* (Parsons 1997) was completed.	January 1997
The *Engineering Evaluation/Cost Analysis for Nontime-Critical Removal Action for Unexploded Ordnance at the Idaho National Engineering and Environmental Laboratory Operable Unit 10-03* (DOE-ID 1997) was completed.	June 1997

Table 12-2. (continued).

Event	Date
The *Summary Report for the 1997 Non-Time Critical Removal Action for Ordnance at Operable Unit 10-03* (INEEL 1999) was completed.	January 1999
The *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Groups 6 and 10 Operable Unit 10-04* (DOE-ID 2001) was completed.	August 2001
The *Waste Area Group 10, Operable Unit 10-08, Remedial Investigation/Feasibility Study Work Plan (Final)* (DOE-ID 2002a) was completed.	August 2002
The *Record of Decision – Experimental Breeder Reactor-I/Boiling Water Reactor Experiment Area and Miscellaneous Sites* (DOE-ID 2002b) was completed.	November 2002
The *Operable Units 6-05 and 10-04, Experimental Breeder Reactor-I/Boiling Water* The *Reactor Experiment Area and Miscellaneous Sites, Remedial Design/Remedial Action Scope of Work* (DOE-ID 2003a) was completed.	February 2003
The *U.S. Department of Energy Idaho Operations Office, Lead Agency Action Memorandum Time-Critical Removal Action for Unexploded Ordnance, Operable Unit 10-04, Idaho National Engineering and Environmental Laboratory* (INEEL 2003a) was completed.	February 2003
The *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004a) was completed.	February 2004
The *Summary Report for the 2004 Time-Critical Removal Action for Unexploded Ordnance at Operable Unit 10-04* (ICP 2004) was completed.	July 2004
The *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase II* (DOE-ID 2004b) was completed.	August 2004
The *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2005a) was completed.	January 2005

12.1 Remedial Actions

WAG 10 has completed one ROD with an interim action, four time-critical removal actions, one non-time-critical removal action, and Phase I of four phases to be completed under the OU 10-04 comprehensive ROD. In 1992, the *Declaration of the Record of Decision for Ordnance Interim Action Operable Unit 10-05* (DOE-ID 1992) under OU 10-05 addressed the remediation of 170 acres at six ordnance sites consisting of the CFA-633 naval firing site, the CFA gravel pit and French drain, the explosive storage bunkers, the NOAA site, the Fire Station II zone and range fire burn area, and the Anaconda power line. During the interim action prescribed by the ROD, the action destroyed 130 pieces of UXO, detonated 134 lbs of TNT and 104 lbs of RDX, incinerated (offsite) 185 yd^3 of contaminated soil, and landfilled 8,423 lbs of metal fragments.

A 1994 non-time-critical removal action addressed 141 acres consisting of three ordnance sites, including NODA (surface only), the CFA landfill, and the Twin Buttes Bombing Range. The action destroyed 1,408 pieces of UXO, detonated 22 lbs of bulk high explosives, and landfilled 70,440 lbs of metal fragments. The 1994 non-time-critical removal action continued into 1995, when it addressed 22.56 acres of subsurface ordnance at NODA. The 1995 action destroyed 462 pieces of UXO, detonated 18 lbs of bulk high explosives, and landfilled 39,470 lbs of metal fragments.

A 1996 time-critical removal action addressed 45 acres consisting of four ordnance sites, including UXO east of the RTC, the rail car explosion area, the land mine fuze burn area, and the projectiles in the riverbed adjacent to the rail car area. The action destroyed 221 pieces of UXO, detonated 64 lbs of bulk high explosives, and landfilled 40,250 lbs of metal fragments.

A 1997 non-time-critical removal action addressed 204 acres at eight ordnance sites: NODA, the rail car explosion area, the mass detonation area, the NOAA site, the Experimental Field Station, Fire Station II, the craters east of INTEC, and the land mine fuze burn area. The action destroyed 146 pieces of UXO, detonated 343 lbs of bulk high explosives, and landfilled 40,182 lbs of scrap.

A 2004 time-critical removal action addressed the removal and disposal by detonation of 66 pieces of UXO found at NODA and east of INTEC. The action destroyed 55 5-in. anti-aircraft common rounds and 11 fuzes.

Phase I of the OU 10-04 comprehensive ROD (DOE-ID 2002b) established institutional controls at 28 WAG 10 sites across the INL Site that have been contaminated by various means, including operations and activities associated with the testing of ordnance and explosives. The WAG 10 sites addressed under OU 10-04 include miscellaneous INL sites such as the OMRE leach pond, the sites related to the Experimental Organic-Cooled Reactor (EOCR, which later became the STF), and numerous ordnance areas. In addition, the Phase I remedial action included development of a comprehensive INL sitewide approach for establishing, implementing, enforcing, and monitoring institutional controls and implementing a long-term comprehensive approach for ecological monitoring to ensure protection of the ecosystem at the INL Site.

Details of the interim action, time-critical removal actions, non-time-critical removal actions, and Phase I of the comprehensive ROD are described below. Because field work associated with Phases II, III, and IV of the OU 10-04 comprehensive ROD has not yet taken place, any discussion pertaining to these phases is deferred to the next five-year review, with the exception of a discussion in Subsection 12.3, Progress since Last Review.

12.1.1 Remedy Selection

12.1.1.1 OU 10-05 Interim Action. As outlined in the *Declaration of the Record of Decision for Ordnance Interim Action Operable Unit 10-05* (DOE-ID 1992), the selected remedy for the interim remedial action included the following actions:

- A comprehensive search of historical records pertaining to the Naval Proving Ground and other suspected ordnance sites at the INL Site
- Posting of signs where the public has access to ordnance areas
- A field search of the six identified areas for UXO
- Controlled detonation of the ordnance
- Field sampling of detonation areas and other areas suspected of contamination with explosive compounds
- Excavation of contaminated soils exceeding action levels
- Off-site incineration and disposal of contaminated soils.

This alternative was preferred over the others outlined in the ROD, because it best achieved the goals of the evaluation criteria, given the scope of the action.

12.1.1.2 1994 Non-Time-Critical Removal Action. A non-time-critical removal action was conducted in 1994 under OU 10-03. The governing documents for the action were as follows:

- *Department of Energy Idaho Field Operations Office Lead Agency Action Memorandum for the Non-Time Critical Removal Action at Unexploded Ordnance Locations at the Idaho National Engineering Laboratory (INEL)* (DOE-ID 1994a)

- *Engineering Evaluation/Cost Analysis (EE/CA) for Non-Time-Critical Removal Action at Unexploded Ordnance Locations at the Idaho National Engineering Laboratory (INEL), Operable Unit (OU) 10-03* (INEL 1994a)

- *Department of Energy Idaho Operations Office Lead Agency Action Memorandum for the Non-Time Critical Removal Action of TNT- and RDX-Contaminated Soil, Idaho National Engineering Laboratory* (DOE-ID 1994b)

- *Engineering Evaluation/Cost Analysis for a Non-Time Critical Removal Action of TNT- and RDX-Contaminated Soil at the Idaho National Engineering Laboratory* (INEL 1994b)

The three TNT- and RDX-contaminated soil sites addressed under the action included the CFA-633 naval firing site, the NOAA area, and the Fire Station II area. The three UXO sites included a 40-acre area within NODA, a 90-acre area within the former Twin Buttes Bombing Range, and four 16-in. shells located east of Lincoln Boulevard near Mile Marker 17. For the UXO, the primary objective of the removal action was to mitigate the hazard of uncontrolled detonation of ordnance to site workers, facilities, and public roads. A secondary objective of the removal action was to provide information for planning and conducting the overall OU 10-03 ordnance areas assessment scheduled for 1998. For the TNT- and RDX-contaminated soils, the primary objective of the removal action was to mitigate the potential excess cancer risk associated with personnel inhalation, ingestion, and dermal absorption of soils contaminated with TNT and RDX. The secondary objective was to identify a cost-effective method for treating soil contaminated with explosive residues at the INL Site.

12.1.1.3 1996 Time-Critical Removal Action. As outlined in the *U.S. Department of Energy, Idaho Operations Office Lead Agency Action Memorandum Time-Critical Removal Action Ordnance Areas Operable Unit 10-03 Idaho National Engineering Laboratory (INEL)* (DOE-ID 1996), a time-critical removal action was selected as the alternative to clear four sites (discussed above) of UXO based on a report issued in May 1996 by the Army Corps of Engineers. The memorandum indicated that the time-critical removal action was justified if the ordnance is exposed and directly threatens human lives. The four areas met these criteria. To accomplish the goal of mitigating the threat from the ordnance, the purpose of the time-critical removal action was to locate, clear, and detonate UXO and clear ordnance and explosive waste at the four sites.

12.1.1.4 1997 Non-Time-Critical Removal Action. As outlined in the *Engineering Evaluation Cost Analysis for Nontime-Critical Removal Action for Unexploded Ordnance at the Idaho National Engineering and Environmental Laboratory Operable Unit 10-03* (DOE-ID 1997), a non-time-critical removal action was performed to clear UXO at eight sites at the INL Site: NODA, the rail car explosion area, the mass detonation area, the NOAA grid, the Experimental Field Station, Fire Station II, the craters east of INTEC, and the land mine fuze burn area. The 1997 removal action addressed 111 acres at NODA, 52 acres at the rail car explosion area, 74 acres at the mass detonation area, 27.3 acres at the

NOAA grid, two acres at the Experimental Field Station, 2.5 acres at Fire Station II, five acres at the land mine fuze burn area, and 10 acres at the craters east of INTEC.

The recommended alternative for the removal action was search and detonation of UXO. This alternative was selected, because it was the only one that fully mitigated the explosive hazard to INL Site workers. It was a proven method of eliminating the explosive hazard of uncontrolled detonation and was a cost-effective remedy that could be implemented in a timely fashion.

12.1.1.5 2004 Time-Critical Removal Action. As outlined in the *U.S. Department of Energy Idaho Operations Office, Lead Agency Action Memorandum Time-Critical Removal Action for Unexploded Ordnance, Operable Unit 10-04, Idaho National Engineering and Environmental Laboratory* (INEEL 2003a), a time-critical removal action was warranted to remove UXO discovered after a range fire burned through an area between CFA and the RTC. In addition, several "live" pieces of UXO were discovered east of INTEC. The removal and destruction of UXO by high-order detonation using additional explosives to initiate the detonation addressed the immediate hazards associated with the UXO, namely inadvertent detonation and injury to personnel.

12.1.1.6 OU 10-04 Phase I Remedial Action. As outlined in the *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004a), the Phase I activities for the comprehensive remedial action consisted of developing and implementing institutional controls at OU 10-04 sites and developing and implementing INL sitewide plans for both institutional control and ecological monitoring. Phase I of the remedial design/remedial action (RD/RA) for OU 10-04 also provided for the removal or isolation of identified surface UXO and TNT/RDX fragments that pose an unacceptable near-term physical hazard. Removal or isolation activities during Phase I of the OU 10-04 RD/RA will not initiate full remediation of the contaminated areas.

12.1.2 Remedial Action Objectives

The following subsections describe the remedial action objectives (RAOs) for each of the time-critical and non-time-critical removal actions, the interim action, and Phase I of the OU 10-04 remedial action.

12.1.2.1 OU 10-05 Interim Action. A baseline risk assessment was not completed for OU 10-05 at the time of the interim action ROD but has subsequently been performed under the OU 10-04 comprehensive ROD (DOE-ID 2002b). The main risk associated with the six sites addressed under the interim action was the potential explosive hazard associated with the uncontrolled detonation of UXO. To that end, the primary purpose of the interim action was to reduce those risks by finding and disposing of unexploded ordnance from the six areas identified for the interim action.

Additional risks resulting from exposure to soils contaminated with explosive residues were also addressed during the interim action. Risk-based soil concentrations were back-calculated from the established National Contingency Plan target risk range of 1E-04 to 1E-06 for carcinogenic contaminants and a hazard index of 1 for non-carcinogenic contaminants. Based on those criteria, screening action levels of 440 mg/kg for TNT and 180 mg/kg for RDX were selected to address soils that had concentrations of contaminants exceeding the 1E-04 risk-based soil levels, with cleanup standards for the interim action of 44 mg/kg for TNT and 18 mg/kg for RDX based on the 1E-05 risk-based soil concentrations.

12.1.2.2 1994 Non-Time-Critical Removal Action. As previously stated, the non-time-critical removal action was conducted at three sites for UXO and three separate sites for TNT- and RDX-contaminated soils. The cleanup standards for soils were 44 parts per million (ppm) for TNT and

18 ppm for RDX. The cleanup standards represented the maximum concentration of soil contaminants allowed to remain in placed after excavation of the contaminated locations. The standards were based on the results of risk analysis conducted for the OU 10-04 interim remedial action, with concentrations of 44 ppm for TNT and 18 ppm for RDX, representing an excess cancer risk of 1E-05 based on an occupational dermal contact exposure scenario. This scenario was selected, because it resulted in the lowest risk-based concentrations for the exposure pathway.

12.1.2.3 1996 Time-Critical Removal Action. The 1996 time-critical removal action was implemented at four areas that had recently been discovered and presented an imminent risk to INL Site personnel and the public. It was concluded from a site report by the Army Corps of Engineers ordnance experts that these areas presented a risk that should be addressed immediately. This was based on the corps listing the sites with a risk assessment code of 1, which indicated an immediate hazard. The risk assessment code of 1 was based on the ordnance being exposed and human lives threatened, justifying the implementation of a time-critical removal action. Therefore, the action was taken to remove the UXO from the four areas in an effort to reduce the risk posed by its presence.

12.1.2.4 1997 Non-Time-Critical Removal Action. The primary objective of the 1997 removal action was to mitigate the explosive hazard of uncontrolled detonation of ordnance to INL Site workers. The secondary objective was to remove the soil contaminated with explosives. Sites identified as exceeding the remediation goals were evaluated and remediated in 1998. The remediation goals for TNT, RDX, and dinitrotoluene were as follows:

- 47 mg/kg for TNT
- 180 mg/kg for RDX
- 35 mg/kg for dinitrotoluene.

12.1.2.5 2004 Time-Critical Removal Action. The primary objective of the 2004 time-critical removal action was to remove exposed UXO from critical areas at the INL Site. The projectiles and fuzes identified in these areas presented an imminent risk to INL Site personnel and the public. As previously discussed in the section pertaining to the 1996 time-critical removal action, the guidance from the Army Corps of Engineers indicated that a time-critical removal action is warranted in situations when there is an immediate threat due to exposure to ordnance with the risk of serious injury or death. The critical areas identified for the 2004 time-critical removal action contained 5-in. anti-aircraft projectiles and fuzes that presented an explosion hazard due to high explosives. In addition to the explosion hazard, the items also presented a security risk of deliberate detonation.

12.1.2.6 OU 10-04 Phase I Remedial Action. Institutional controls will be maintained for the WAG 10 sites where risk is greater than 1E-04 (1 in 10,000) for a hypothetical current residential scenario. For purposes of evaluating the need for institutional controls at WAG 10, the potential for current residential risk in excess of 1E-04 was inferred from the risk assessment for the 100-year future residential scenario. Any site with an estimated risk of 1E-06 or greater for the 100-year future residential scenario was assumed to pose a current residential risk of 1E-04. Institutional controls will be implemented and maintained until at least 2095 at WAG 10 sites that pose such a risk, based on the *Idaho National Engineering and Environmental Laboratory Comprehensive Facility and Land Use Plan* (DOE-ID 2005b), or until the site is released for unrestricted use based either on successful remediation of the site or agency agreement in a five-year review that the site is released for unrestricted use.

In addition to implementation of institutional controls at WAG 10 sites, the OU 6-05 and 10-04 ROD (DOE-ID 2002b) mandated development of a comprehensive INL-wide approach for establishing, implementing, enforcing, and monitoring institutional controls in accordance with EPA Region 10 policy

(EPA 1999). The ROD also provided that an institutional control status report would be submitted to the agencies within six months of the ROD signature and that the report would be updated at least annually thereafter until the first five-year review. The ROD (DOE-ID 2002b) also mandated implementation of an INL-wide, long-term comprehensive approach for ecological monitoring to ensure protection of the ecosystem at the INL Site.

12.1.3 Remedy Implementation

12.1.3.1 OU 10-05 Interim Action. The results of the OU 10-05 interim action are documented in the *Remedial Action Report for the Interim Action to Cleanup Unexploded Ordnance Locations at the INEL (Operable Unit 10-05)* (Wyle 1994). The specific mission of the interim action was to locate, identify, detonate, and dispose of UXO and associated shrapnel and to characterize, remove, and incinerate soils contaminated with explosive residues at six sites. The six sites addressed under the interim action were the CFA gravel pit, the unexploded storage bunkers north of INTEC, the NOAA grid, the CFA-633 naval firing site, and the Anaconda power line. The specific tasks included the completion of visual and geophysical searches, removal of ordnance and explosive particulate, initial sampling of selected areas, removal of contaminated soil, verification sampling of excavated areas, reclamation of the sites, and shipment of contaminated soil for disposal.

Ordnance was located and either disposed of by detonation or demilitarized, with the scrap metal disposed of at the CFA landfill, and the explosive was disposed of by detonation. Items included an electric squib, illumination candles, grenades, projectiles, fuze components, and miscellaneous UXO. During searches to locate UXO, evidence of soil contamination was found and flagged for sampling. Soil contamination was noted at Fire Station II, the CFA-633 naval firing site, and the NOAA area. Locations identified during the sampling effort that exceeded the action levels of 440 ppm TNT and 180 ppm RDX were excavated and containerized for shipment offsite for disposal by incineration. In most cases, the sampling results indicated that the contamination was limited to within 4 in. of the surface. An iterative process of excavation followed by verification sampling was implemented to ensure that contamination exceeding the action levels had been removed. A total of 201 1-yd^3 boxes were filled with contaminated soil, most of which originated from the CFA-633 area, with smaller amounts coming from the NOAA and Fire Station II areas. The areas impacted by the excavation activities were reseeded.

12.1.3.2 1994 Non-Time-Critical Removal Action. The 1994 action was carried out over 16 months, beginning in 1994 with the cleanup of the Twin Buttes Bombing Range, the four projectiles located east of Lincoln Boulevard at Mile Marker 17, and a portion of the NODA. Cleanup of the remainder of the NODA site was completed during the summer and fall of 1995. The *Removal Action Report for the Ordnance Removal Action, Operable Unit 10-03* (Wyle 1995a) summarizes the work performed in 1994, and the *Addendum to the Removal Action Report for the Ordnance Removal Action, Operable Unit 10-03* (Wyle 1995b) updates the report as to the work completed in 1995. Work-specific tasks included mobilization to the site, a visual UXO search of the site followed by a geophysical search, and ordnance and scrap removal. The located UXO was either destroyed in place or transported to the mass detonation area for disposal by high-order detonation. Demilitarized UXO was inspected to ensure that no hazard remained and was then taken to the CFA landfill for disposal.

The selected remedy for the TNT- and RDX-contaminated soils was bioremediation. A treatability study was completed in 1999, as documented in the *Waste Area Group 10 RDX/TNT CERCLA Treatability Study Final Report* (INEEL 2000). The study demonstrated that the technology was technically feasible; however, the OU 10-04 comprehensive ROD (DOE-ID 2002b) provides a selected remedy of removal by excavation over bioremediation. The TNT and RDX portion of the 1994 non-time-critical removal action has not been completed but will be addressed under Phase II of the OU 10-04 remedial action scheduled for 2007.

12.1.3.3 1996 Time-Critical Removal Action. The results of the 1996 time-critical removal action are documented in the *Final Action Report for the Time Critical Removal Action, Operable Unit 10-03* (Parsons 1997). The primary tasks included mobilization to the site, visual search for UXO, ordnance and scrap removal, a geophysical search for UXO followed by analysis of geophysical survey data, demilitarization of ordnance items, and disposal of ordnance and explosive items by detonation. Within the land mine fuze burn area, a total of 1,018 individual fuzes were removed, 118 of which contained explosives. Additionally, over 36,000 lbs of scrap and approximately 60 lbs of raw explosive were also removed from the area. Scrap removed from the rail car explosion area included over 4,250 lbs of inert materials, including rail car components and ordnance residue. In addition, several other explosive items, including portions of 18 aerial bombs and 10 5-in. projectiles were collected from various locations and destroyed during demolition operations. All loose explosives encountered during the project were collected and destroyed during the demolition of the UXO.

12.1.3.4 1997 Non-Time-Critical Removal Action. The *Summary Report for the 1997 Non-Time Critical Removal Action for Ordnance at Operable Unit 10-03* (INEEL 1999) presents the results of the 1997 non-time-critical removal action. The areas included were the NODA, the NOAA grid, the Fire Station II zone, the mass detonation area, the Experimental Field Station, the rail car explosion area, the land mine fuze burn area, and the craters east of INTEC. Ordnance removal was completed at four of the eight sites: the NOAA grid, the Fire Station II zone, the Experimental Field Station, and the craters east of INTEC. Further removal of ordnance was required at the remaining four sites after the 1997 non-time-critical removal action was completed. The removal action at these four sites was not completed in 1997 because of programmatic funding constraints. However, the removal action for the NODA grid was completed as part of the 2004 time-critical removal action. Removal actions for the mass detonation area, the rail car explosion area, and the land mine fuze burn area will be addressed under Phase IV of the OU 10-04 remedial action, which is currently planned to begin in 2007.

12.1.3.5 2004 Time-Critical Removal Action. The *Summary Report for the 2004 Time-Critical Removal Action for Unexploded Ordnance at Operable Unit 10-04* (ICP 2004) summarizes the results of the 2004 time-critical removal action. The objective of the time-critical removal action was to remove, transport, and destroy UXO that was found near the NODA and INTEC. The UXO was recovered, transported to the mass detonation area, and destroyed by high-order detonation. A total of 55 5-in. anti-aircraft common rounds and 11 fuzes were recovered and disposed of.

12.1.3.6 OU 10-04 Phase I Remedial Action. Implementation of the OU 10-04 Phase I remedial action is discussed in the *Remedial Action Report for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2005a). The primary purpose of the Phase I remedial action was to establish institutional controls at 28 WAG 10 sites that have been contaminated by various means, including operations and activities associated with the testing of ordnance and explosives. The WAG 10 sites assessed under Phase I of OU 10-04 included the LCCDA; the OMRE leach pond; the sites related to the EOCR (which later became the STF); the STF sumps, pits, and gun range; and numerous ordnance areas.

Implementation of institutional controls included emplacement of institutional control signs at the applicable WAG 10 sites and visible access restrictions to the INL Site. Land use restrictions for the WAG 10 sites require that the DOE Idaho Operations Office (DOE Idaho) notify the EPA and DEQ before any transfer, sale, or lease to a nonfederal entity (such as a state or local government or a private person) of any DOE Idaho managed real property that is the subject of institutional controls required by the OU 6-05 and 10-04 ROD (DOE-ID 2002b). Restrictions on drilling or excavation activities within the institutionally controlled WAG 10 sites require completion of an environmental checklist, with conditions that must be met before beginning a project that might disturb soil within a specified site. The checklist must also identify the applicable instructions that the drilling/excavation project must comply with as well as any applicable or relevant and appropriate requirements.

The *Operations and Maintenance Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004c) describes the long-term RD/RA activities for Phase I of OU 10-04 at the INL Site. These activities include removal or isolation of surface ordnance and explosives discovered during routine operations that, based on expert evaluation, pose an unacceptable near-term physical hazard. The *INEEL Sitewide Institutional Controls Plan* (DOE-ID 2004d) documents the site-specific institutional controls currently in place at the INL Site. The plan identifies common institutional control measures and describes methods used to inspect institutionally controlled sites and methods to evaluate whether the institutional control requirements are being met. The *Long-Term Ecological Monitoring Plan for the Idaho National Engineering and Environmental Laboratory* (INEEL 2004) presents the approach for INL long-term ecological monitoring and two primary objectives. The first is to verify that the objectives of each INL Site remedial action are maintained. The second is to determine that the long-term, INL sitewide ecological impact of the contamination left in place is within acceptable limits. In accordance with that plan, an annual field sampling plan will be prepared to describe the field investigations to be performed within a fiscal year. Once the monitoring is completed for a particular year, an annual report that summarizes the results of the monitoring effort will be prepared.

12.2 Data Evaluation

12.2.1 Site Inspections

Institutional control inspections are conducted annually at WAG 10 sites. The following summaries discuss annual inspections sites conducted at WAG 10 within the timeframe of this five-year review.

Institutional controls inspections were required within six moths of signature of the ROD and were completed in March 2003 (INEEL 2003b). No deficiencies were identified during the 2003 inspection; however, the sites were posted with “Environmentally Controlled Area” signs, which needed to be replaced with the standardized institutional control sign. Signs were replaced during inspections conducted in June 2004 (DOE-ID 2004e). Visible access restrictions, control of activities, and land-use restrictions were evaluated, and no deficiencies were identified.

Operations and maintenance at WAG 10 consist of removal or isolation of surface ordnance and explosives discovered during routine operations. Consequently, dedicated operations and maintenance inspections are not conducted at WAG 10.

12.2.2 Time-Critical Removal Actions

For the 1996 time-critical removal action and the 2004 time-critical removal action, actions were implemented to reduce the risk to personnel and the public due to the presence of UXO. No remediation of contaminated soils was performed; therefore, no data were collected. The selected remedy for the 1994 non-time-critical removal action for TNT- and RDX-contaminated soils was bioremediation. As discussed previously, the TNT and RDX portion of the 1994 non-time-critical removal action was not completed; therefore, no data evaluation is required. For the OU 10-04 comprehensive ROD, the remedial actions have yet to be performed. Data evaluation is limited to the OU 10-05 interim action.

12.2.2.1 Operable Unit 10-05 Interim Action. As stated previously, sampling during the OU 10-05 interim action was performed at Fire Station II, the CFA-633 naval firing site, and the NOAA area. The cleanup standards for the interim action were 44 mg/kg for TNT and 18 mg/kg for RDX. For the CFA-633 area, the TNT verification sample results ranged from below the method detection limit to a maximum of 6.4 mg/kg, with a single result outside of the normal range of 228 mg/kg. The RDX results ranged from below the method detection limit to a maximum of 24 mg/kg. The maximum results were below the defined action levels for the interim action.

The NOAA area TNT verification sample results ranged from below the method detection limit to a maximum of 6.7 mg/kg. All RDX verification sample results were below the method detection limit. For the Fire Station II area, the TNT verification sample results ranged from below the method detection limit to a maximum of 29 mg/kg, while the RDX verification sample results ranged from below the method detection limit to a maximum of 1.1 mg/kg.

12.2.2.2 1997 Non-Time-Critical Removal Action. For the 1997 non-time-critical removal action, sampling was not completed at seven of the eight sights, because either the ordnance removal was not complete or insufficient time remained in the 1997 field season. Soil sampling for these seven sites was deferred to the OU 10-04 RI/FS. Sampling was completed during the 1997 non-time-critical removal action at the mass detonation area. The remediation goals for TNT, RDX, and dinitrotoluene were defined as 47 mg/kg, 180 mg/kg, and 35 mg/kg, respectively. The RDX results were below the method detection limit. The dinitrotoluene results ranged from below the method detection limit to a maximum of 1.6 mg/kg. The TNT results ranged from below the method detection limit to a maximum of 94 mg/kg.

12.3 Progress since Last Review

This is the first five-year review conducted for WAG 10. However, ongoing remediation activities at include the maintenance of institutional controls at the WAG 10 sites and continued operations and maintenance activities and ecological monitoring, as defined for the OU 10-04 Phase I remedial action. Future activities include implementation of OU 10-04 Phases II through IV and preparation of the OU 10-08 RI/FS and subsequent ROD.

12.3.1 OU 10-04 Phase I Activities

As discussed previously, the OU 10-04 Phase I remedial action consists of the following four main activities:

- Implementation and maintenance of institutional controls at WAG 10 sites
- Operations and maintenance activities, specifically to include the removal and disposal of ordnance and explosives that pose an imminent hazard to human health
- Preparation and implementation of an INL sitewide institutional controls plan
- Preparation and implementation of an INL sitewide long-term ecological monitoring plan.

The 28 WAG 10 sites requiring institutional controls are as follows:

- OMRE-01: OMRE leach pond
- ORD-01: Arco High-Altitude Bombing Range
- ORD-03: CFA-633 naval firing site and downrange area
- ORD-04: CFA gravel pit
- ORD-05: CFA sanitary landfill area
- ORD-06: NODA
- ORD-07: Explosive storage bunkers – north of INTEC
- ORD-08: NOAA area

- ORD-09: Twin Buttes Bombing Range
- ORD-10: Fire Station II zone and range fire burn area
- ORD-11: Anaconda power line
- ORD-12: old military structures
- ORD-13: mass detonation area
- ORD-14: dairy farm revetments
- ORD-15: Experimental Field Station
- ORD-16: unexploded ordnance east of the RTC (formerly the TRA)
- ORD-17: burn ring south of the Experimental Field Station
- ORD-18: igloo-type structures northwest of the Experimental Field Station
- ORD-19: rail car explosion area
- ORD-20: unexploded ordnance east of the Army Reentry Vehicle Facility site
- ORD-21: Juniper Mine
- ORD-22: projectiles found near Mile Markers 17, 18, and 19
- ORD-24: land mine fuze burn area
- ORD-25: ordnance and dry explosives east of the Big Lost River (same as ORD-19)
- ORD-26: zone east of the Big Lost River
- ORD-27: dirt mounts near the Experimental Field Station, NOAA, and NRF
- ORD-28: craters east of INTEC
- STF-02: STF gun range.

Institutional controls will remain in place at these 28 sites until the remediation is either successfully completed or the controls are discontinued based on the results of a five-year review.

12.3.2 OU 10-04 Phase II Activities

The requirements for the OU 10-04 Phase II activities are delineated in the *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase II* (DOE-ID 2004b). Specifically, Phase II addresses the removal and destruction of TNT and RDX fragments found on five sites and remediation of chemically contaminated (principally TNT and RDX) soil found at the explosive test sites. The following five sites are located within the Naval Proving Ground:

- Fire Station II zone and range fire burn area
- Experimental Field Station
- Land mine fuze burn area
- NOAA area
- NODA.

The remediation of the TNT/RDX-contaminated soil sites will include (a) establishing and maintaining institutional controls during Phase I (as required) until the contamination is removed or reduced to acceptable levels, (b) performing a visual survey to identify any UXO and TNT/RDX fragments and stained soil coupled with a geophysical survey for UXO, (c) excavating contaminated soil, (d) segregating and disposing of TNT/RDX fragments at the mass detonation area, (e) sampling and analyzing soil to determine excavation requirements and when the remediation goals have been achieved, (f) backfilling and contouring excavated areas, (g) revegetating affected areas, and (h) monitoring air and soil during the remedial action.

The current working schedule for the Phase II activities provides that the remedial action field work will commence in October 2007, with a projected completion date of August 2008. The draft Phase II remedial action report will be submitted to the agencies in November 2008, with an enforceable date of November 30, 2015.

12.3.3 OU 10-04 Phase III Activities

The *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase III (Draft)*[a] outlines the requirements for the OU 10-04 Phase III activities that address the remediation of lead-contaminated soil at the STF-02 gun range. Remediation of the gun range will include (a) excavation of contaminated soil, (b) physical separation of copper and lead for recycling (if allowed by DOE policy), (c) returning to the site any separated soils that are below the remediation goal, (d) stabilization of contaminated soils as required, (e) disposal of the separated soils that exceed the remediation goal, (f) encapsulation of creosote-contaminated railroad ties and disposal, (g) removal and disposal of the wooden building and asphalt pads found at the gun range, (h) sampling and analysis of soil to determine excavation requirements and when the remediation goals have been met, (i) backfilling and contouring excavated areas, and (j) revegetating the affected area.

The current working schedule for the Phase III activities provides that the remedial action field work will commence in October 2009, with completion slated for October 2010. The draft Phase III remedial action report will be submitted to the agencies in March 2011, with an enforceable date of August 31, 2018.

12.3.4 OU 10-04 Phase IV Activities

The OU 10-04 Phase IV activities address the remediation of UXO-contaminated sites. The RD/RA work plan for Phase IV will be prepared in fiscal year (FY) 2006. The three main sites requiring remediation for UXO include the Naval Proving Ground, the Arco High-Altitude Bombing Range, and the Twin Buttes Bombing Range. The Naval Proving Ground includes 29 smaller ordnance sites; six of the sites have a high probability for and/or the confirmed presence of UXO. These six smaller sites include the Experimental Field Station, the NOAA area, the land mine fuze burn area, the mass detonation area, the rail car explosion area, and NODA. Because the mass detonation area will be used for the disposal of UXO and explosives by detonation, the area will be further assessed for the presence of explosives during the Phase IV activities and remediated for explosives in addition to UXO, as necessary.

As defined in the *Operable Units 6-05 and 10-04, Experimental Breeder Reactor I/Boiling Water Reactor Experiment Area and Miscellaneous Sites, Remedial Design/Remedial Action Scope of Work* (DOE-ID 2003a), the draft RD/RA work plan will be prepared in FY 2006, with an enforceable date of submittal to the agencies for review by July 31, 2006. The remedial action field work will commence with

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a. *Remedial Design/Remedial Action Work Plan for Operable Unit 6-05 and 10-04, Phase III (Draft),* DOE/NE-ID-11202, Rev. 0, U.S. Department of Energy Idaho Operations Office, March 2005.

the mobilization for UXO surveys in February 2011 followed by UXO removal and disposal by detonation. The working schedule date for the Phase IV remedial action report provides for submittal of the draft for review by the agencies in November 2013, with an enforceable date of September 2020. The working schedule date for the remedial action report might be accelerated based on the new contract for INL Site cleanup; the fieldwork schedule might be moved forward as well.

12.3.5 OU 10-08 New Sites, Track 1s, and Track 2s

As per the *Comprehensive Remedial Investigation/Feasibility Study for Waste Area Group 6 and 10, Operable Unit 10-04* (DOE-ID 2001), the OU 10-04 responsibilities discussed in the FFA/CO have been modified by the inclusion of OU 10-08. The OU 10-08 RI/FS scope includes the evaluation of the INL sitewide groundwater concerns, the evaluation of new sites that are passed to WAG 10 by other WAGs, and the evaluation of new sites that are discovered after the OU 10-04 RI/FS process is completed. OU 10-08 may also be responsible for characterizing and performing necessary remedial activities at new sites discovered inside the boundaries of WAGs 1 through 7.

To date, a total of 76 new sites have been included for evaluation under OU 10-08. These sites include three from CFA, three from the Power Burst Facility (PBF), 15 from the RTC, nine from TAN, and 48 miscellaneous sites outside of the other WAGs. Table 12-3 summarizes the OU 10-08 sites and the current determination for each of them.

12.3.6 OU 10-08 Snake River Plain Aquifer

One of the primary purposes of OU 10-08 is the comprehensive evaluation of impacts to groundwater from operations at the INL Site. Some of these operations have introduced radioactive and hazardous contaminants into the environment, and a number of these contaminants have been found in the SRPA. The potential impacts to the groundwater from INL Site activities are being thoroughly investigated as part of the OU 10-08 RI/FS.

The comprehensive nature and scope of OU 10-08 necessitate that monitoring data be collected over many years and long-term integration be maintained among individual WAGs to ensure that all data needed are available for the OU 10-08 RI/FS. The large area of the OU 10-08 domain and the long groundwater travel times require long-term monitoring of water quality and water levels to adequately characterize the SRPA for risk-assessment calculations. In addition, it is critical that the OU 10-08 numerical and conceptual model be interfaced with the other individual WAG models to create a comprehensive understanding of the aquifer flow regime, contaminant sources, and contaminant transport in the SRPA. An integrated understanding of the overall health of the SRPA beneath the INL Site is critical for communicating INL impacts to others who use SRPA water.

The work scope of the OU 10-08 RI/FS is based on filling data gaps originally identified in the OU 10-08 RI/FS work plan (DOE-ID 2002a). The activities in the work scope are necessary to characterize and assess INL-wide groundwater risks and will ultimately be used in the OU 10-08 ROD. It is important to note that many of the tasks done under the OU 10-08 RI/FS also support individual WAGs. For example, the groundwater flow characteristics and INL-scale subsurface stratigraphy are used as boundary conditions for the smaller "windows" in the SRPA studied by individual WAGs. In addition, assessment of intermingling plumes between INTEC and RWMC will impact risk assessment calculations. The tasks identified in the OU 10-08 RI/FS work plan and the progress made toward their completion are summarized in reports published annually. To date, the OU 10-08 RI/FS annual report for FY 2004 (DOE-ID 2004f) and the OU 10-08 RI/FS annual status report for FY 2004 (DOE-ID 2005c) have been submitted to the agencies for their review.

Table 12-3. OU 10-08 new sites.

WAG of Origin	Site Code	Description	Activity	Recommendation	Approval Date[a]
1	TAN-30	TAN/Technical Support Facility (TSF) Fire Station wastewater system discharge drainage ditch	New site identification (NSI)	No action	01/31/2005
1	TSF-08	TSF Heat Transfer Reactor Experiment III mercury spill area	Explanation of significant differences (ESD)	Risk reevaluation under OU 10-08 RI/FS	Pending
1	TSF-49	1-TAN Idaho Department of Water Resources (IDWR) #1 TAN-702	NSI	No action	Pending
1	TSF-50	2-TAN IDWR#2 TAN-724	NSI	No action	Pending
1	TSF-51	TAN-607A pool release	NSI in preparation	—	—
1	TSF-52	TAN-607 Decontamination Shop waste discharge pipe	NSI	Evaluate under the OU 10-08 RI/FS	Pending
1	TSF-53	Saturated soil on the west side of TAN-633	NSI in preparation	—	—
1	TSF-54	Soil beneath TAN-607 Decontamination Shop sump	NSI	Evaluate under the OU 10-08 RI/FS	Pending
1	TSF-55	Soil in pipe trench west of TAN-666	NSI	Evaluate under the OU 10-08 RI/FS	Pending
2	TRA-56	TRA acid transfer line from TRA-631 to TRA-645	Track 1	To be evaluated under OU 10-08 comprehensive RI/FS; maintain institutional controls	02/26/2003
2	TRA-57	Abandoned buried diesel fuel oil line	Track 1	To be evaluated under OU 10-08 comprehensive RI/FS	05/09/2002
2	TRA-59	Abandoned buried acid line from TRA-631 to TRA-671	Track 1	No further action	02/26/2003
2	TRA-60	Fenced area north of TRA-608	Track 2	No further action	Pending
2	TRA-62	Abandoned discharge lines, TRA-608 area to TRA-701 chemical leach pond	Track 2 investigation ongoing	—	—
2	TRA-63	TRA-605 warm waste line	Track 2	No further action	Pending

Table 12-3. (continued).

WAG of Origin	Site Code	Description	Activity	Recommendation	Approval Date[a]
2	TRA-64	5-TRA IDWR #12 TRA field drain (FD)5	NSI	No action	Pending
2	TRA-65	7-TRA IDWR#15 TRA FD7	NSI	No action	Pending
2	TRA-66	8-TRA IDWR#16 TRA FD8	NSI	No action	Pending
2	TRA-67	13-TRA IDWR#21 TRA FD13	NSI	No action	Pending
2	TRA-68	14-TRA IDWR#22 TRA FD14	NSI	No action	Pending
2	TRA-69	15-TRA IDWR#23 TRA FD15	NSI	No action	Pending
2	TRA-70	19-TRA IDWR#27 TRA FD19	NSI	No action	Pending
2	TRA-71	20-TRA IDWR#None TRA FD20	NSI	No action	Pending
2	TRA-72	21-TRA IDWR#None TRA FD21	NSI	No action	Pending
4	CFA-10A	Soil-filled concrete ring adjacent to CFA-667	Track 2	No action	Pending
4	CFA-53	Soil beneath CFA-617 wastewater piping and drains	NSI	No further action	Pending
4	CFA-54	Buried waste pipe south of CFA-674	Track 2	Investigation ongoing	Pending
5	PBF-33	Abandoned debris trench	Track 1	No action; remove asbestos-containing debris	Pending
5	PBF-34	Abandoned debris located near the Mixed Waste Storage Facility	Track 11	No action	Pending
5	PBF-35	Abandoned power and control cables between buildings at the PBF complex	Track 1	No action	01/14/2005
10	MISC-01	Debris along Big Lost River near RWMC	Track 1	No further action	03/29/2002
10	MISC-02	Car body south of Highway 33 on INL Boundary Road	Track 1	No further action	08/25/2004
10	MISC-03	Car body adjacent to Big Lost River	Track 1	No further action	04/02/2002
10	MISC-04	Diesel-saturated dirt pile near Experimental Field Station	Track 1	Characterize for hydrocarbons	01/14/2005
10	MISC-05	Excavation pit/mound and debris east of Guard Gate 3	Track 1	No further action	Pending
10	MISC-06	Cistern north of NRF	Track 1	No further action	04/02/2002

Table 12-3. (continued).

WAG of Origin	Site Code	Description	Activity	Recommendation	Approval Date[a]
10	MISC-07	Debris near cinder pit on the INL southern border	Track 1	No further action	04/02/2002
10	MISC-08	Debris near intersection of Highways 33 and 22	Track 1	No further action	Pending
10	MISC-09	Debris south of Highway 33 east of TAN	Track 1	No action	09/03/2004
10	MISC-10	Debris in canal west of Guard Gate 3	Track 1	No action	01/14/2005
10	MISC-11	Debris west of the southern end of Highway 22	Track 1	No further action	04/02/2002
10	MISC-12	Debris north of Highway 33 near the west entrance	Track 1	No further action	04/02/2002
10	MISC-13	Debris next to canal inside boundary of NRF	Track 1	No further action	04/02/2002
10	MISC-14	Debris in the Big Lost River sinks area	Track 1	No further action	04/02/2002
10	MISC-15	Navy debris in canal between RTC and NRF	Track 1	No further action	Pending
10	MISC-16	Farming debris in Big Lost River sinks area	Track 1	No further action	09/03/2004
10	MISC-17	Staining on East Butte Road	Track 1	No action	01/14/2005
10	MISC-18	Uncapped well in Big Lost River sinks area	Track 1	No action, abandon in accordance with Idaho Administrative Procedures Act standards	01/14/2005
10	MISC-19	Homestead site at Birch Creek and Cedar Canyon Road	Track 1	No further action	04/02/2002
10	MISC-20	Stained road near NRF	Track 1	No further action	04/02/2002
10	MISC-21	Staining on Road 17 from STF to Portland Road	Track 1	No action	01/14/2005
10	MISC-22	Rusty metal debris adjacent to Highway 28	Track 1	No action	09/03/2004
10	MISC-23	Debris in Birch Creek drainage gravel pit	Track 1	No further action	04/02/2002
10	MISC-24	Homestead site northwest of the Specific Manufacturing Capability	Track 1	No further action	04/02/2002
10	MISC-25	Mounds, cans, and drums northeast of NRF	Track 1	Perform total petroleum hydrocarbon analyses to determine need for Track 2	Pending

Table 12-3. (continued).

WAG of Origin	Site Code	Description	Activity	Recommendation	Approval Date[a]
10	MISC-26	Detonation pit between NRF and TRA	Track 1	ESD to OU 10-04 ROD for inclusion	01/14/2005
10	MISC-27	Mound near East Portland/East Ogden intersection	Track 1	No action	01/14/2005
10	MISC-28	Canal builder's campsite	Track 1	No action	01/14/2005
10	MISC-29	Asphalt near main guard gate	Track 1	No further action	09/03/2004
10	MISC-30	Debris on Richard Butte	Track 1	Remove batteries and analyze soil for zinc; if noncompliant, include in OU 10-08; if compliant, no action	01/14/2005
10	MISC-31	Two 8-in.-diameter rounds	Track 1	No action	01/14/2005
10	MISC-32	Mound near RWMC gravel pit	Track 1	No action	01/14/2005
10	MISC-33	Experimental test drum in EOCR-01 leach pond	Track 2	No action	Pending
10	MISC-34	Howe Peak diesel spill	Track 1	No action	01/14/2005
10	MISC-35	Detonation pits north of EOCR	Track 1	ESD to OU 10-04 ROD for inclusion	01/14/2005
10	MISC-36	Debris southwest of Highway 28	Track 1	No action	09/03/2004
10	MISC-37	Lids by Experimental Field Station	Track 1	No action	01/14/2005
10	MISC-38	Uncapped well east of Materials and Fuels Complex	Track 1	No action; abandon in accordance with Idaho Administrative Procedures Act regulations	01/14/2005
10	MISC-39	Ammunition remains in EOCR area	Track 1	No action	01/14/2005
10	MISC-40	Mound southeast of EOCR buildings	Track 1	No action	01/14/2005
10	MISC-41	Pits/mounds northeast of EOCR	Track 1	No action	01/14/2005
10	MISC-42	Construction debris northeast of EOCR	Track 1	No action	01/14/2005

Table 12-3. (continued).

WAG of Origin	Site Code	Description	Activity	Recommendation	Approval Date[a]
10	MISC-43	Construction pit northwest of EOCR	Track 1	No action	01/14/2005
10	MISC-44	Concrete-lined depression west of CFA	Track 1	No action	01/14/2005
10	MISC-45	Dirt pile with naval smoke cans near INTEC	Track 1	Track 2	01/14/2005
			Track 2 investigation ongoing	—	—
10	MISC-46	Test apparatus west of CFA	Track 1	No further action; remove trash	09/03/2004
10	MISC-47	Small fuel tank north of INTEC	Track 1	No action; remove tank	01/14/2005
10	MISC-48	Mud Lake landfill	NSI	No action	Pending

a. Documents identified as pending require agency approval/signoff by one or more of the agencies.

The 11 main tasks required to be completed for the OU 10-08 RI/FS are as follows:

1. Develop a comprehensive database of groundwater sample results.

2. Evaluate groundwater.

3. Evaluate alternative groundwater sampling and purging methodology.

4. Evaluate potentially commingled plumes.

5. Evaluate groundwater quality for current compliance with maximum contaminant levels or other risk-based concentrations.

6. Develop a method to incorporate new sites into OU 10-08.

7. Evaluate phytoremediation of mercury in soil at Site TSF-08.

8. Revise the sitewide groundwater model.

9. Implement institutional controls.

10. Evaluate risk to groundwater.

11. Verify water-level measuring points.

To date, Tasks 1, 3, 6, 9, and 11 have been completed. For Task 1, all sampling data are now entered into the Environmental Data Warehouse, which was developed under the purview of the Long-term Stewardship Project. The evaluation of alternative groundwater sampling and purging methodology that comprise Task 3 were completed in FY 2003, with a report of the study provided in Appendix C of the FY 2003 annual RI/FS report (DOE-ID 2004f). Task 6 has been satisfied with the completion and implementation of Management Control Procedure (MCP)-3448, "Inclusion of New Sites under the Federal Facility Agreement and Consent Order," which details the procedures for reporting new sites and provides direction for listing them the appropriate WAG. Implementation of institutional controls, as required by Task 9, has been accomplished through the development of the *INEEL Sitewide Institutional Controls Plan* (DOE-ID 2004d), which was completed as part of the *Remedial Design/Remedial Action Work Plan for Operable Units 6-05 and 10-04, Phase I* (DOE-ID 2004a) in FY 2004. Task 11, consisting of the verification of water-level measuring points, was completed in FY 2004 and was documented in the *Long-Term Stewardship Fiscal Year 2004 Well Surveillance/Maintenance Report* (ICP 2005).

With the exception of Task 7, the evaluation of phytoremediation of mercury in the soil at Site TSF-08, the remaining tasks revolve around the evaluation of the groundwater defined by the SRPA and preparing updated conceptual and numerical groundwater models for OU 10-08. The *Idaho National Engineering and Environmental Laboratory Operable Unit 10-08 Sitewide Groundwater Model Work Plan* (DOE-ID 2004g) outlines the work elements associated with modeling efforts required to support OU 10-08. These models will support a comprehensive evaluation and cumulative risk analysis of environmental impacts from INL Site operations to the underlying SRPA for the OU 10-08 RI/FS. Additionally, the model will serve to integrate knowledge gained during investigations of individual WAGs into a comprehensive aquifer management tool for long-term stewardship responsibilities. The efforts will consist of revising and documenting the subregional conceptual model of groundwater flow at the INL Site based on current knowledge, identification of data gaps and the recommended approach for filling those gaps, preparation of an OU 10-08 numerical model of subregional groundwater flow based on the updated conceptual model, and development of a numerical model of contaminant transport to support a comprehensive INL Site groundwater risk assessment.

For Task 7, the residual risk associated with the mercury contamination remaining at Site TSF-08, a removal action was performed in 1994, and the area was backfilled with clean gravel. Post-removal sampling showed low levels of mercury at least 2.5 ft below ground surface. The site was transferred to WAG 10, based on agency agreement that the site should be included under the OU 10-08 RI/FS and future ROD. The *Explanation of Significant Differences for the Record of Decision for the Test Area North Operable Unit 1-10* (DOE-ID 2003b) outlines this change. A reevaluation of the final remediation goal for mercury is now warranted for human and ecological receptors, because new guidance and information from the EPA are available. The risk to human health and the environment will be evaluated in FY 2005 under OU 10-08.

12.4 Technical Assessment

Question A: *Is the remedy functioning as intended by the decision documents?*

According to sampling data and site inspections, all COCs are at or below action levels as defined for the actions that have taken place to date. It is important to recognize that key remedial actions have yet to be performed, as defined in the OU 10-04 comprehensive ROD (DOE-ID 2002b). At sites where contaminant concentrations prohibit free release of the site or remedial actions have yet to be implemented, institutional controls have been established in accordance with Phase I of the OU 10-04 remedial action.

Question B: *Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?*

For interim actions with certain exposure assumptions or toxicological parameters that were used to derive the specified cleanup levels, changes in the parameters have occurred that would negatively impact the original assumptions. With the subsequent development of the OU 10-04 comprehensive ROD (DOE-ID 2002b), the new exposure assumptions and toxicological parameters were used to assess all of the OU 10-04 contaminated soil sites. Based on these revised parameters, updated remediation goals have been developed for OU 10-04 sites where contamination that poses an unacceptable risk to human health or the environment exists. Those sites will subsequently be remediated for TNT, RDX, or 1,2-dinitrobenzene contamination, as applicable, during Phase II of the OU 10-04 remedial action scheduled to begin in October 2007.

Question C: *Has any other information come to light that would call into question the protectiveness of the remedy?*

As previously stated, the OU 10-04 comprehensive ROD (DOE-ID 2002b) addresses sites requiring remediation based on current exposure and toxicological data. Once implemented, the remedy will be protective of human health and the environment.

12.5 Issues

There are no issues regarding the remedial actions that have been completed at WAG 10.

12.6 Recommendations and Follow-up Actions

No additional recommendations need to be provided at this time, given that the remedial actions involving the TNT/RDX-contaminated soil sites, the lead-contaminated soil at the STF-02 gun range, and the UXO sites are yet to be implemented and the OU 10-08 comprehensive ROD is yet to be written.

12.7 Protectiveness Statement

Institutional controls have been implemented at WAG 10 sites where contamination currently exists and might pose an unacceptable risk to human health or the environment. The use of institutional controls will preclude the inadvertent exposure of personnel and the public until such time as the remedial action is implemented. Overall protectiveness of the defined remedy will be evaluated upon completion.

12.8 Section 12 References

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13. SUMMARY AND CONCLUSIONS

Based on the review of remedial actions at the Idaho National Laboratory (INL) Site, completed remedies are functioning as intended in the decision documents. Remedial actions have been completed at Waste Area Groups (WAG) 2, 4, 5, and 9 and are nearing completion at Operable Unit (OU) 1-10. The evidence presented in the upcoming remedial action reports is expected to indicate that the selected remedies have achieved the remedial action objectives.

Past remedial actions at the INL Site used risk-based concentrations provided by the Fromm (1996) memorandum. Those remedial actions should be considered effective, because Cs-137 is the primary radionuclide of concern and the remediation activities used a lower (more conservative value) than would be required under the new guidance issued by the U.S. Environmental Protection Agency (EPA). By cleaning to the more protective level, it is assumed that any other radionuclides that would have been present are also now at acceptable levels.

Changes in the slope factors and guidance on the calculation of radionuclide preliminary remediation goals presented on the EPA Web site (http://epa-prgs.ornl.gov/radionuclides/) should be incorporated in all future assessments and cleanup at the INL Site. This includes the new slope factors as well as changes to the calculation of preliminary remediation goals, including the use of a gamma shielding factor.

The overall remedial action objectives remain the same, because they are based on a cancer incidence of 1E-04 or a hazard index of less than 1. However, because the preliminary remediation goals established in the new EPA guidance have changed, the U.S. Department of Energy Idaho Operations Office will, with agency concurrence, determine how best to address the impact of the new guidelines before the next five-year review.

Remedial actions that are not operational and functional yet or are still in the design or investigation stage pose no imminent or substantial threats to human health or the environment and require no actions beyond those prescribed in the records of decision issued through the federal facility agreement and consent order process. When remedial actions are completed, the remedies are expected to function as intended per the decision document and be protective of human health and the environment.

Because the mission for the Materials and Fuels Complex (WAG 9) has been changed, the sewage lagoons there are expected to be used until approximately 2030. Therefore, they have been administratively transferred to WAG 10 to allow for closure of WAG 9.

Remedies for the no-further-action or institutionally controlled sites appear to be effective at limiting unauthorized access and excavation. Based on results from the annual assessments of institutionally controlled sites, the controls are in place and the sitewide approach to institutional controls has streamlined the assessment process.

13.1 Section 13 References

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14. NEXT REVIEW

The next sitewide five-year review at the Idaho National Laboratory Site will be conducted within five years of this report being issued.

Appendix A

Evaluation of Slope Factors and Risk-Based Concentration Changes

Appendix A

Evaluation of Slope Factors and Risk-Based Concentration Changes

A-1. INTRODUCTION

Based on U.S. Environmental Protection Agency (EPA) five-year review guidance, toxicity values (slope factors and reference doses [RfDs]) and associated risk-based concentrations (RBCs) used in the risk assessments should be reviewed for changes. This appendix compared the slope factors, RfDs, and RBCs (also called preliminary remediation goals [PRGs] by the EPA) used in the waste area group (WAG) risk assessments to the newest values available from the Integrated Risk Information System (IRIS) (http://www.epa.gov/iris/), Health Effects Assessment Summary Tables (HEAST), or other approved sources. Slope factors for several nonradionuclides have changed or have been developed since 1997. The changes were minimal and should not impact the remediation decisions. The changes to the radionuclide slope factor and new guidance for calculating RBCs for radionuclides are more significant. Recommendations for addressing those changes are included in this appendix.

A-2. RADIONUCLIDES

The EPA classifies all radionuclides as Group A carcinogens. The EPA provides a radionuclide table (http://www.epa.gov/radiation/heast/) that lists ingestion, inhalation, and external exposure cancer slope factors (risk coefficients for total cancer morbidity) for radionuclides in conventional units of picocuries (pCi). Ingestion and inhalation slope factors are central estimates in a linear model of the age-averaged, lifetime-attributable radiation cancer incidence (fatal and nonfatal cancer) risk per unit of activity inhaled or ingested, expressed as risk/pCi. External exposure slope factors are central estimates of lifetime attributable radiation cancer-incidence risk for each year of exposure to external radiation from photon-emitting radionuclides distributed uniformly in a thick layer of soil and are expressed as risk/yr per pCi/gram soil. These slope factors, when combined with site-specific media concentration data and appropriate exposure assumptions, are used to estimate lifetime cancer risks at the Idaho National Laboratory (INL) Site as a result of radionuclide exposures.

The slope factors are also used to calculate RBCs/PRGs for use in screening and development of cleanup goals. The PRGs and the methodology used to develop them are presented at http://epa-prgs.ornl.gov/radionuclides/. Both the slope factors and RBCs that were used in the initial risk assessments performed for the WAGs undergoing a five-year review have changed because of new EPA guidance. The changes are discussed in the following subsections.

A-2.1 Radionuclide Slope Factors

Radionuclide slope factors used in the assessments for the comprehensive remedial investigations and feasibility studies performed before the middle of 2001 for the WAGs in this five-year review were taken from HEAST (EPA 1995). On April 16, 2001, HEAST was updated to incorporate all new values, based on Federal Guidance Report No. 13, which was developed by the EPA's Office of Radiation and Indoor Air (Eckerman and Ryman 1993). The update incorporates state-of-the-art models and methods that take into account age and gender dependence for radionuclide intake, metabolism, dosimetry, radiogenic cancer risk, and competing risks. Major differences between the risk coefficients of Federal Guidance Report No. 13 (as incorporated into the current radionuclide slope factors) and the preceding generation of radionuclide slope factors (published in the November 1995 HEAST) include the following:

- Consideration of revised dosimetric models, including a revised lung model, age-dependent biokinetic models, gastrointestinal absorption factors for internal dose estimates, and revised external dose coefficients for external dose estimates
- Consideration of age- and gender-dependent inhalation and ingestion rates
- Incorporation of updated vital statistics and baseline cancer mortality data
- Specification of separate values for ingestion of water, food products, and soil, based on the different age-dependent intake rate functions for such materials instead of the single ingestion value for each radionuclide presented previously.

The age- and gender-specific radiogenic cancer risk models for each of the 14 potential cancer sites used to compute the risk coefficients in Federal Guidance Report No. 13 are similar to those used for previous radionuclide slope-factor calculations, based on the EPA report *Estimating Radiogenic Cancer Risk* (EPA 1994). However, the risk models have been updated to incorporate more recent baseline cancer mortality data and other minor adjustments. The estimate of total radiogenic cancer risk attributable to uniform total-body exposure from low doses of low-linear energy transfer radiation has increased by approximately 11 to 13% from the previous estimates, primarily because of changes in the baseline cancer mortality rates for the U.S. population.

Table A-1 presents a comparison of the 1995 slope factors to the 2001 values. The list of radionuclides includes those from the WAGs in this five-year review and those in the Fromm (1996) risk-based concentration tables. Some important differences are apparent. First, slope factors are now available for ingestion of water, food products, and soil. Previously, only one general slope factor for ingestion was available from HEAST (EPA 1995). Conservatively, the lowest of either the food or the soil ingestion value from the 2001 values was compared to the 1995 ingestion values. Based on Federal Guidance Report No. 13 (Eckerman and Ryman 1993), beta emitters now include external dose. This produced major changes to the Sr-90 and C-14 slope factors, because they now have a slope factor for external exposure.

A larger slope factor equates to a greater possible risk to the receptor. As can be seen from the radionuclides included in this list, over 50% have a greater slope factor; therefore, risk assessments performed using these values may not be conservative. As noted, however, most of these values are less than 10 times greater for most radionuclides, with the exception of the external slope factors. The external slope factors have changed significantly. That is, both Sr-90 and C-14 have an external slope factor, and the slope factor for Tc-99 is more than 100 times greater than it was in 1995.

A-2.2 Radionuclide Preliminary Remediation Goals

Since 1996, INL Site personnel have screened radionuclides and used the RBCs for cleanup goals provided by the Fromm (1996) memorandum. It developed radionuclide RBCs for 43 radionuclides using the HEAST 1995 slope factors and the assumptions about shielding at that time. The exposure scenarios from Fromm (1996) address 25-year worker and 30-year residential exposure durations. The risk-based concentrations are based on a current exposure scenario or on a scenario occurring either 30 or 100 years in the future. In the 100-year future scenario, a worker would be exposed from 100 to 125 years from the present, while a residential receptor would be exposed from 100 to 130 years from the present. The equations used were adapted from those in DOE (1994), which in turn were adapted from the *Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual* (EPA 1991).

Based on the 2001 guidance and slope factors, the EPA has developed PRGs for the current worker (outdoor and indoor), residential soil, agricultural soil, residential soil, tap water, fish ingestion, and groundwater protection. The approach used by the EPA to calculate PRGs includes the use of a gamma-shielding factor that provides for a more realistic assessment of exposure.

Table A-2 presents a comparison of the new EPA PRGs to the risk-based concentrations presented in Fromm (1996). To provide the comparison, current resident values were decayed to 2095, as described in Fromm (1996). This provided a future residential PRG similar to that used at the INL Site for the 100-year residential scenario. In addition, the outdoor worker soil PRGs were compared to the current worker PRGs from Fromm (1996).

The EPA changes have both increased and decreased the associated slope factors and PRGs from those used in the past for cleanup at the INL Site. Due to the improved guidance, the new EPA slope factors and PRGs should provide a more accurate evaluation of risk. However, the changes were not immediately addressed, because the primary driver for cleanup at most INL sites is Cs-137. Based on new EPA PRGs, the cleanup goal for Cs-137 would be 40 pCi/g, whereas it is currently 23 pCi/g.

A-2.3 Discussion

As shown in Table A-1, although many of the slope factors have increased, a corresponding increase in the EPA PRGs is not evident, as shown in Table A-2. This is due to the fact that the new guidance for development of PRGs allows for the inclusion of several factors that reduce the exposure in the calculations—primarily, a gamma-shielding factor (GSF) and an area correction factor (ACF). These factors were not included in the development of Fromm's (1996) RBC and generally reduce the amount of exposure and result in a higher PRG.

The GSF is the ratio of the external gamma radiation level indoors onsite to the radiation level outdoors onsite. The GSF is based on the fact that a building provides shielding against penetration of gamma radiation. Therefore, the calculation of the risk posed by gamma radiation from radionuclides in the soil should take into account this shielding effect. The EPA's previous GSF default value—taken from Part B of the *Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual* (EPA 1991)—is 0.8, which assumes that the external gamma radiation level indoors is 20% lower than the outdoor gamma radiation level. This value was not included in the calculation of RBCs for the INL Site provided by Fromm (1996) and was not included in the risk calculations.

The EPA did a further review of the literature presented in the EPA report *Reassessment of Radium and Thorium Soil Concentrations and Annual Dose Rates* (EPA 1996). The review revealed numerous publications that address indoor/outdoor GSFs as applied to radioactive fallout from nuclear weapons and reactor accidents. In the *Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A)* (EPA 1989), the authors reviewed experimentally measured reduction factors from fallout. The authors concluded that "reduction factors of 0.4 to 0.2 are recommended as representative values for above-ground lightly constructed (wood frame) and heavily constructed (block and brick) homes, respectively." On the basis of that review, EPA (1996) suggests that a default GSF of 0.4 based solely on the contribution of terrestrial radiation might be a more appropriate value to use at sites with soil contaminated with radionuclides than the previous EPA default of 0.8, which also included the effects of cosmic radiation and the inherent radioactivity in structure materials. Based on that rationale, the EPA adopted in its new guidance the value of 0.4 as the default GSF.

To accommodate the fact that in most residential settings the assumption of an infinite slab source will result in overly conservative soil screening levels, an adjustment for source area is considered to be an important modification to the *Risk Assessment Guidance for Superfund, Vol. I, Human Health Evaluation Manual* Part B model (EPA 1991). Thus, an ACF has been added to the calculation of soil screening levels (EPA 2000). The default is 0.9.

Based on the availability of this new guidance, the State of Idaho is currently in the process of developing a radionuclide calculator and RBCs. When the calculator becomes available or based on the EPA's RBCs, the cleanup values at the INL Site should be evaluated against the new guidance. Although the approach used at the INL Site was extremely conservative to both ensure protection of the human receptors and the environment, it is advisable to minimize expenditures for cleanup activities and eliminate unnecessary institutional controls. The new EPA PRG guidance also allows for the development of site-specific PRGs that should also be considered.

A-2.4 Recommendations

Past remediation efforts at the INL Site used RBCs provided by Fromm (1996). Those remediation efforts should be considered effective, because Cs-137 is the primary radionuclide of concern and the remediation activities used a lower, more conservative value than would be required by the new EPA guidance. By cleaning to the more protective level, it is assumed that any other radionuclides that were present would also be at acceptable levels. The changes in the slope factors and guidance on the calculation of radionuclide PRGs presented on the EPA Web site (http://epa-prgs.ornl.gov/radionuclides/) should be incorporated into all future assessments and cleanup at the INL Site. This includes the new slope factors as well as the use of a GSF and an ACF.

The overall remedial action objectives remain the same, because the remedial action objectives are based on a cancer incidence of 1E-04 or a hazard index of less than 1. However, the new information provided by the EPA should supersede the previous remediation goals, and new cleanup goals should be developed.

A-3. NONRADIONUCLIDES

Slope factors and RfDs are constantly being updated as new toxicity data become available. They are primarily developed using the toxicological data from laboratory studies on animals. Human data from epidemiologic studies are used when available. INL Site personnel obtained most of the RfDs and slope factors used to calculate the health risk limits from the IRIS, an electronic database containing health risk and regulatory information on more than 500 chemicals. The EPA acknowledges IRIS as the source for reference doses and slope factors that have undergone the most thorough and standardized scientific review.

Table A-3 is a compilation of the contaminants of potential concern (COPCs) identified at each WAG undergoing a five-year review; the table also presents the toxicity values used in the associated risk assessment. The values for chronic oral and inhalation RfDs and chronic oral and inhalation slope factors are compared to those currently presented in IRIS. A higher toxicity value indicates greater toxicity. A lower toxicity value indicates less toxicity. Therefore, if a toxicity value has changed from that used in a risk assessment and the new value is less than the old, then the risk assessment is overly conservative. However, if the new value is higher, then it is possible that the risk assessment was not conservative enough. As can be seen, the toxicity factors for several of the contaminants have changed. Most of the changes are less than an order of magnitude larger. Generally, the radionuclides drive cleanup activities at INL sites, so any of the changes would be unlikely to have an impact on previous remediation decisions.

The largest changes are in the area of the development of new and more realistic inhalation values. The slope factors for inhalation appear to present some of the largest changes, with new values now available for PCBs. The inhalation RfDs have also changed but not to the same extent. These changes are not expected to make a significant impact on the results of any of the baseline risk assessment results currently under five-year review.

The comprehensive remedial investigations/feasibility studies at the INL Site use conceptual site models to identify for assessment the following exposure scenarios, exposure pathways, and exposure routes:

- Exposure scenarios
  - Current occupational
  - Future occupational
  - Residential intrusion
- Exposure pathways
  - Groundwater
  - Air captured
- Soil exposure routes
  - Ingestion
    - Soil
    - Groundwater (residential intrusion scenario only)
    - Homegrown produce (residential intrusion scenario only)
  - Inhalation
    - Fugitive dust
    - Volatiles from soil.

For inhalation, all retained sites that have contamination in the top 10 ft of soil are assumed to have a contaminant source that can be released into the air pathway. The exposure routes that are evaluated as part of the air pathway analysis are as follows:

- Inhalation of fugitive dust
- Inhalation of volatiles

The concentration of each COPC in the respirable particulate matter is assumed to equal the average soil concentration. Averaging contaminant concentrations above the site for the air pathway produces one contaminant-specific risk estimate for each air pathway exposure route (i.e., for each time period, each air pathway exposure route has the same risk or hazard index at every retained site). The equations used were designed to produce high estimates of airborne COPC concentrations, because no credit is taken for dilution of airborne concentrations caused by dust blown from uncontaminated areas of the INL Site.

To quantify risks for the future residential receptor, contaminant concentrations in groundwater were modeled. For the groundwater pathway analysis, every contaminant that is not eliminated by the contaminant screening process was assumed to have the potential for migrating to groundwater. The following exposure routes are evaluated as part of the groundwater pathway analysis:

- Ingestion of groundwater
- Dermal absorption of groundwater
- Inhalation of volatiles produced by indoor use of groundwater.

This approach generally has resulted in inhalation being a minor contributor to the total risk. Table A-4 shows a comparison of the changes to risk if the inhalation is reevaluated for the future resident based on the WAG 5 Operable Unit (OU) 5-12 comprehensive remedial investigation/feasibility study (DOE 1999). Only the risk from fugitive dust will be evaluated, because there was no risk from volatiles in soil or groundwater at WAG 5 (DOE 1999, Appendix B).

As is shown in Table A-4, WAG 5 was broken into six groups. As discussed above, the fugitive dust was calculated across these groups and then added back into the total risk by site. The total risk by each site is compared to the percent of risk contributed by fugitive dust. As can be seen, all but Site ARA-24 has inhalation risk that contributes more than 0.1% to the total risk. Table A-3 was evaluated to determine the COPCs that had major changes in their slope factors, and the risk from these COPCs is addressed individually. Many of the polychlorinated biphenyls (PCBs) now have a slope factor to calculate risk, and they have been included; cadmium has increased from 1.8E-03 to 6.3 and has been included; chromium (VI) has increased from 1.2E-02 to 4.2E+01 and is discussed; and arsenic is included, because it is one of the largest contributors from risk.

Table A-4 presents both the original results and the recalculated results. Although a cadmium slope factor was presented in Table B-20 of the OU 5-12 remedial investigation/feasibility study, the cadmium slope factor was not calculated. Also, a thallium slope factor for inhalation is not presented in Table B-20, but it is assumed that the ingestion slope factor was to calculate the value presented for conservatism. Additionally, although only total chromium was sampled for at WAG 5 sites (DOE 1999, Appendix B), the risk assessment assumed that both chromium (III) and chromium (VI) were represented by the total chromium concentration. Chromium is most likely to be in a chromium (III) form at the INL Site, and assuming that the total concentration contains a large portion of chromium (VI) in the soil is unrealistic. Chromium should be assessed as chromium (III), because chromium is not expected to persist in the environment at the INL Site in the chromium (VI) form (Bartlett and Kimble 1976; Rai, Eary, and Zachara 1989). Sample data collected from 10 grid locations at Site PBF-10 (a dried pond site) for both chromium (VI) and (III) support this assumption. The average ratio of the chromium (VI) to (III) soil concentrations is 0.0085 (ranging from 0.00017 to 0.053). Based on the total chromium sampling, the intake of chromium (VI) was calculated to be 1.44E-10 mg/kg-day (DOE 1999, Table B-60). Based on the average ratio of chromium (VI) to chromium (III) (as calculated from PBF-10 data), this should be reduced to 1.2E-12 mg/kg-day (i.e., 0.0085 times 1.44E-10 mg/kg-day) for Group 1 and 2.6E-10 mg/kg-day (i.e., 0.0085 times 3.18E-08 mg/kg-day) for Group 2. Therefore, the risk from inhalation of chromium (VI) was recalculated using these more realistic assumptions.

Based on these observations and new information, the risk contribution from inhalation decreases at all sites, as shown in Table A-4. The risk driver for Site ARA-24 was the risk of inhalation of chromium. This is still the largest contributor to total risk, but based on this more realistic approach, the risk is now lower than before even when using the larger slope factors.

In summary, it is apparent that inhalation is not a driver in the risk assessments using the approach accepted at the INL Site. The changes made to the slope factors and RfDs should not impact the conclusions made in the individual WAG comprehensive baseline risk assessment. Currently, the EPA is including the evaluation of indoor air quality due to particulates emitted from soil for both residents and workers. If the risk assessment approach is updated at the INL Site, the inclusion of this exposure route should be considered.

A-3 REFERENCES

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Table A-1. Comparison of 2001 slope factors to 1995 values.

Isotope	from HEAST 2001						from HEAST 1995			Is new slope factor greater than (+) or less than (-) old? How many times greater? (The lower the slope factor the less the risk.)					
	Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Max Ingestion Slope Factor (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External (Risk/y per pCi)	Ingestion		Inhalation		External	
Ag-108m	8.14E-12	1.12E-11	1.92E-11	1.92E-11	2.67E-11	7.18E-06	6.05E-12	7.02E-11	5.61E-06	+	—	-	—	+	1.3
Am-241	1.04E-10	1.34E-10	2.17E-10	2.17E-10	2.81E-08	2.76E-08	3.28E-10	3.85E-08	4.59E-09	-	—	-	—	+	6.0
Ba-133	6.81E-12	9.44E-12	1.39E-11	1.39E-11	1.16E-11	1.44E-06	2.70E-12	4.03E-12	9.15E-07	+	—	+	—	+	1.6
Bi-212	7.10E-13	9.99E-13	1.78E-12	1.78E-12	7.77E-11	8.87E-07	6.20E-13	3.65E-11	6.67E-07	+	—	+	—	+	1.3
Bi-214	1.92E-13	2.65E-13	4.33E-13	4.33E-13	2.90E-11	7.48E-06	1.95E-13	1.46E-11	6.02E-06	+	—	+	—	+	1.2
Ce-144+D	3.53E-11	5.19E-11	1.02E-10	1.02E-10	1.10E-10	2.44E-07	2.97E-11	1.08E-10	1.56E-07	+	3.4	+	1.0	+	1.6
C-14	1.55E-12	2.00E-12	2.79E-12	2.79E-12	7.07E-12	7.83E-12	1.03E-12	6.99E-15	No SF	+	2.7	+	1011.4	+	a
Co-57	1.04E-12	1.49E-12	2.78E-12	2.78E-12	2.09E-12	3.55E-07	9.70E-13	2.90E-12	2.10E-07	+	2.9	-	—	+	1.7
Co-58	2.95E-12	4.18E-12	7.44E-12	7.44E-12	5.99E-12	4.48E-06	2.80E-12	5.20E-12	3.70E-06	+	2.7	+	1.2	+	1.2
Co-60	1.57E-11	2.23E-11	4.03E-11	4.03E-11	3.58E-11	1.24E-05	1.89E-11	6.88E-11	9.76E-06	+	2.1	-	—	+	1.3
Cs-134	4.22E-11	5.14E-11	5.81E-11	5.81E-11	1.65E-11	7.10E-06	4.73E-11	2.89E-11	5.88E-06	+	1.2	-	—	+	1.2
Cs-137+D	3.04E-11	3.74E-11	4.33E-11	4.33E-11	1.19E-11	2.55E-06	3.16E-11	1.91E-11	2.09E-06	+	1.4	-	—	+	1.2
Cm-242	3.85E-11	5.48E-11	1.05E-10	1.05E-10	1.51E-08	7.73E-11	3.83E-11	3.16E-09	2.34E-11	+	2.7	+	4.8	+	3.3
Cm-244	8.36E-11	1.08E-10	1.81E-10	1.81E-10	2.53E-08	4.85E-11	2.11E-10	2.43E-08	2.07E-11	-	—	+	1.0	+	2.3
Eu-152	6.07E-12	8.70E-12	1.62E-11	1.62E-11	9.10E-11	5.30E-06	5.73E-12	7.91E-11	4.08E-06	+	2.8	+	1.2	+	1.3
Eu-154	1.03E-11	1.49E-11	2.85E-11	2.85E-11	1.15E-10	5.83E-06	9.37E-12	9.15E-11	4.65E-06	+	3.0	+	1.3	+	1.3
Eu-155	1.90E-12	2.77E-12	5.40E-12	5.40E-12	1.48E-11	1.24E-07	1.65E-12	9.60E-12	6.08E-08	+	3.3	+	1.5	+	2.0
H-3 (organic)	1.12E-13	1.44E-13	2.20E-13	2.20E-13	1.99E-13	No SF	7.15E-14	9.59E-14	No SF	+	3.1	+	2.1	+	NA
H-3 (vapor)	5.07E-14	6.51E-14	9.25E-14	9.25E-14	5.62E-14	No SF	No SF	No SF	No SF	NA	NA	NA	NA	NA	NA
I-129	1.48E-10	3.22E-10	2.71E-10	3.22E-10	6.07E-11	6.10E-09	1.84E-10	1.22E-10	2.69E-09	+	1.8	-	—	+	2.3
Fe-55	8.62E-13	1.16E-12	2.09E-12	2.09E-12	7.99E-13	No SF	3.51E-13	5.60E-13	No SF	+	6.0	+	1.4	+	—
Pb-214	3.44E-13	4.85E-13	8.51E-13	8.51E-13	3.63E-11	9.82E-07	2.94E-13	6.23E-12	7.09E-07	+	2.9	+	5.8	+	1.4
Mn-54	2.28E-12	3.11E-12	5.14E-12	5.14E-12	5.88E-12	3.89E-06	1.96E-12	3.69E-12	3.26E-06	+	2.6	+	1.6	+	1.2
Np-237+D	6.74E-11	9.10E-11	1.62E-10	1.62E-10	1.77E-08	7.97E-07	3.00E-10	3.45E-08	4.62E-07	-	—	-	—	+	1.7
Ni-59	2.74E-13	3.89E-13	7.33E-13	7.33E-13	4.66E-13	No SF	1.85E-13	4.01E-13	No SF	+	4.0	+	1.2	+	—
Ni-63	6.70E-13	9.51E-13	1.79E-12	1.79E-12	1.64E-12	No SF	5.50E-13	1.01E-12	No SF	+	3.3	+	1.6	+	—
Nb-95	2.45E-12	3.50E-12	6.36E-12	6.36E-12	5.44E-12	3.53E-06	2.30E-12	3.10E-12	2.90E-06	+	2.8	+	1.8	+	1.2
Pu-238	1.31E-10	1.69E-10	2.72E-10	2.72E-10	3.36E-08	7.22E-11	2.95E-10	2.74E-08	1.94E-11	-	—	+	1.2	+	3.7
Pu-239	1.35E-10	1.74E-10	2.76E-10	2.76E-10	3.33E-08	2.00E-10	3.16E-10	2.78E-08	1.26E-11	-	—	+	1.2	+	15.9
Pu-240	1.35E-10	1.74E-10	2.77E-10	2.77E-10	3.33E-08	6.98E-11	3.15E-10	2.78E-08	1.87E-11	-	—	+	1.2	+	3.7
Pu-241[b]	1.76E-12	2.28E-12	3.29E-12	3.29E-12	3.34E-10	4.11E-12	3.33E-10	3.88E-08	4.59E-09	-	—	-	—	-	—
Pu-242	1.28E-10	1.65E-10	2.63E-10	2.63E-10	3.13E-08	6.25E-11	3.00E-10	2.64E-08	1.55E-11	-	—	+	1.2	+	4.0
K-40	2.47E-11	3.43E-11	6.18E-11	6.18E-11	1.03E-11	7.97E-07	1.25E-11	7.46E-12	6.11E-07	+	4.9	+	1.4	+	1.3
Ra-226 +D	3.86E-10	5.15E-10	7.30E-10	7.30E-10	1.16E-08	8.49E-06	2.96E-10	2.75E-09	6.74E-06	+	2.5	+	—	+	1.3
Ru-106+D	4.22E-11	6.11E-11	1.19E-10	1.19E-10	1.02E-10	9.66E-07	3.45E-11	1.15E-10	7.57E-07	+	3.4	-	—	+	1.3
Sb-125+D	5.13E-12	7.21E-12	1.32E-11	1.32E-11	1.93E-11	1.81E-06	3.54E-12	5.85E-12	1.34E-06	+	3.7	+	3.3	+	1.4
Sr-90+D	7.40E-11	9.53E-11	1.44E-10	1.44E-10	1.13E-10	1.96E-08	5.59E-11	6.93E-11	No SF	+	2.6	+	1.6	+	a
Tc-99	2.75E-12	4.00E-12	7.66E-12	7.66E-12	1.41E-11	8.14E-11	1.40E-12	2.89E-12	6.19E-13	+	5.5	+	4.9	+	131.5
Th-228+D	3.00E-10	4.22E-10	8.09E-10	8.09E-10	1.43E-07	7.76E-06	2.31E-10	9.68E-08	9.94E-07	+	3.5	+	1.5	+	7.8
Th-230	9.10E-11	1.19E-10	2.02E-10	2.02E-10	2.85E-08	8.19E-10	3.75E-11	1.72E-08	4.40E-11	+	5.4	+	1.7	+	18.6
Th-232	1.01E-10	1.33E-10	2.31E-10	2.31E-10	4.33E-08	3.42E-10	3.28E-11	1.93E-08	1.97E-11	+	7.0	+	2.2	+	17.4
U-232	2.92E-10	3.85E-10	5.74E-10	5.74E-10	1.95E-08	5.98E-10	8.12E-11	5.29E-08	3.42E-11	+	7.1	-	—	+	17.5
U-233	7.18E-11	9.69E-11	1.60E-10	1.60E-10	1.16E-08	9.82E-10	4.50E-11	1.40E-08	3.50E-11	+	3.6	-	—	+	28.1

Table A-1. (continued).

Isotope	from HEAST 2001 Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Max Ingestion Slope Factor (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	from HEAST 1995 Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External (Risk/y per pCi)	Is new slope factor greater than (+) or less than (-) old? How many times greater? (The lower the slope factor the less the risk.) Ingestion		Inhalation		External	
U-234	7.07E-11	9.55E-11	1.58E-10	1.58E-10	1.14E-08	2.52E-10	4.44E-11	1.40E-08	2.14E-11	+	3.6	-	—	+	11.8
U-235+D	7.18E-11	9.76E-11	1.63E-10	1.63E-10	1.01E-08	5.43E-07	4.70E-11	1.30E-08	2.65E-07	+	3.5	-	—	+	2.0
U-236	6.70E-11	9.03E-11	1.49E-10	1.49E-10	1.05E-08	1.25E-10	4.21E-11	1.32E-08	1.72E-11	+	3.5	-	—	+	7.3
U-238+D	8.71E-11	1.21E-10	2.10E-10	2.10E-10	9.35E-09	1.14E-07	6.20E-11	1.24E-08	5.25E-08	+	3.4	-	—	+	2.2
Zn-65	1.17E-11	1.54E-11	2.45E-11	2.45E-11	5.81E-12	2.81E-06	9.93E-12	9.98E-12	2.27E-06	+	2.5	-	—	+	1.2
Zr-93	1.11E-12	1.44E-12	2.12E-12	2.12E-12	7.29E-12	No SF	5.21E-13	5.26E-12	No SF	+	4.1	+	1.4	NA	NA
Zr-95	4.59E-12	6.59E-12	1.23E-11	1.23E-11	1.65E-11	3.40E-06	3.92E-12	6.48E-12	2.81E-06	+	3.1	+	2.5	-	1.2

a. There were no external exposure values in the 1995 HEAST.

b. Pu-241 was assessed with its daughter product in 1996 (Fromm 1996). However, the new HEAST does not present this radionuclide with its daughter.

Note: For tritium, two sets of values are provided for ingestion and inhalation pathways. The values in the first line represent ingestion of H-3 in the form of tritiated water and inhalation of tritiated water vapor, while values in the second line represent ingestion of organically bound tritium and inhalation of H-3 in particulate form (with default International Commission on Radiological Protection lung absorption Type M). The corresponding value for inhalation of H-3 in organically bound gas would be greater than the value for tritiated water vapor by a factor of 2.3, while the value for inhalation of elemental hydrogen gas would be lower by a factor of 10,000. Fromm (1996) did not differentiate these factors.

Table A-2. Comparison of 1996 RBCs with EPA PRGs.

Isotope	Risk Based Concentration from Fromm (1996) Future Resident (pCi/g)	Current Resident (pCi/g)	Current Worker (pCi/g)	Preliminary Remediation Goals (PRG) Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/gL)	Fish Ingestion (pCi/g)	Soil to Groundwater DAF=20 (pCi/g)	DAF=1 (pCi/g)	EPA PRG for Residential Soil Decayed to 2095 (pCi/g)	EPA PRG is greater (+) or less (-) than old? How many times less? Current Worker		Current Resident		Future 2095 Resident	
Ag-108m	NA	NA	NA	1.68E-02	6.29E-03	3.25E-02	7.32E-02	5.85E+00	1.57E-01	3.99E-01	1.99E-02	1.68E-02	NA	NA	NA	NA	NA	NA
Am-241	2.90E+00	2.50E+00	1.00E+01	1.87E+00	1.32E-02	5.67E+00	1.19E+01	4.58E-01	1.32E-02	2.58E+00	1.29E-01	1.87E+00	-	1.8	-	46.6	-	46.6
Ba-133	NA	NA	NA	1.75E-01	1.61E-01	3.06E-01	6.89E-01	6.99E+00	1.87E-01			1.75E-01	NA	NA	NA	NA	NA	NA
Bi-212	NA	NA	NA	2.26E+04	2.24E+04	3.70E+04	8.33E+04	6.71E+01	1.77E+00			2.26E+04	NA	NA	NA	NA	NA	NA
Bi-214	NA	NA	NA	8.19E+03	8.19E+03	1.34E+04	3.01E+04	2.48E+02	6.66E+00			8.18E+03	NA	NA	NA	NA	-	NA
Ce-144+D	2.90E+39	1.50E+01	6.30E+01	1.14E+01	3.45E+00	1.99E+01	4.49E+01	1.35E+00	3.40E-02	5.64E+02	2.82E+01	1.14E+01	-	3.2	-	1.3	+	3851.7
C-14	7.90E+02	7.80E+02	3.10E+03	4.56E-01	5.63E-05	1.23E+03	2.24E+03	1.29E+00	8.82E-01	4.01E+01	2.00E+00	4.56E-01	-	2.5	-	1710.5	-	1713.7
Co-57	NA	NA	NA	8.73E+00	9.66E-02	1.44E+01	3.23E+01	4.58E+01	1.18E+00	1.68E+02	8.40E+00	8.73E+00	NA	NA	NA	NA	NA	NA
Co-58	NA	NA	NA	2.66E+00	1.27E-01	4.36E+00	9.80E+00	1.61E+01	4.22E-01	1.11E+03	5.56E+01	2.66E+00	NA	NA	NA	NA	NA	NA
Co-60	7.40E+03	1.60E-02	7.20E-02	3.61E-02	9.01E-04	6.02E-02	1.35E-01	3.03E+00	7.91E-02	2.41E+00	1.21E-01	3.61E-02	-	1.2	+		+	1.5
Cs-134	2.40E+13	8.40E-02	3.60E-01	1.57E-01	7.47E-03	2.59E-01	5.82E-01	1.13E+00	3.43E-02	1.65E+02	8.24E+00	1.57E-01	-	1.4	+		+	10.8
Cs-137+D	2.30E-01	2.40E-02	1.20E-01	5.97E-02	1.20E-03	1.13E-01	2.53E-01	1.57E+00	4.72E-02	5.66E+01	2.83E+00	5.97E-02	-	1.1	+		+	
Cm-242	2.40E+70	4.60E+03	1.50E+04	3.22E+02	1.89E+01	3.20E+03	5.92E+03	1.24E+00	3.22E-02	4.62E+03	2.31E+02	3.22E+02	-	4.7	-	14.3	-	16019678.3
Cm-244	2.90E+02	6.60E+00	2.40E+01	6.69E+00	3.04E-01	3.79E+01	6.90E+01	5.70E-01	1.63E-02	4.35E+01	2.17E+00	6.69E+00	+		+		+	1.4
Eu-152	2.70E+00	1.80E-02	8.20E-02	4.16E-02	3.76E-02	7.37E-02	1.66E-01	7.84E+00	2.03E-01			4.16E-02	-	1.1	+		+	
Eu-154	5.20E+01	2.10E-02	9.60E-02	4.99E-02	4.72E-02	8.57E-02	1.93E-01	4.62E+00	1.18E-01			4.99E-02	-	1.1	+		+	2.6
Eu-155	2.90E+06	2.80E+00	1.20E+01	3.80E+00	3.74E+00	6.34E+00	1.43E+01	2.51E+01	6.37E-01			3.80E+00	-	1.9	+		+	
H-3 (organic)	6.50E+06	2.50E+04	8.80E+04	2.28E+00	1.60E-01	1.42E+00	3.20E+00		1.22E+01			2.88E+00	-	61971.8	-	10964.9	-	18624.4
H-3 (vapor)	NA	NA	NA					1.44E+02		1.65E+02	8.25E+00		NA	NA	NA	NA	NA	NA
I-129	4.30E+00	4.30E+00	1.70E+01	5.96E-01	2.76E-05	1.09E+01	2.08E+01	3.22E-01	5.48E-03	4.60E-03	2.30E-04	5.96E-01	-	1.6	-	7.2	-	7.2
Fe-55	2.50E+15	2.30E+04	7.60E+04	2.69E+03	8.21E-01	2.21E+04	3.97E+04	5.52E+01	1.52E+00	1.02E+03	5.08E+01	2.69E+03	-	3.4	-	8.6	-	85.9
Pb-214	1.40E+13	6.30E-01	2.70E+00	4.63E+04	3.49E+04	7.56E+04	1.70E+05	1.38E+02	3.64E+00	2.85E+12	1.43E+11	4.63E+04	+		+		+	
Mn-54	3.30E+34	5.80E-01	2.50E+00	6.92E-01	3.69E-01	1.13E+00	2.55E+00	2.09E+01	5.67E-01	7.42E+02	3.71E+01	6.92E-01	-	2.2	+		+	1215.3
Np-237+D	7.60E-02	7.60E-02	3.90E-01	1.30E-01	4.48E-04	2.72E-01	6.11E-01	7.07E-01	1.94E-02	9.00E-02	4.50E-03	1.30E-01	-	1.4	+		+	
Ni-59	4.30E+03	4.30E+03	1.70E+04	2.08E+02	2.15E+00	1.23E+04	2.22E+04	1.74E+02	4.53E+00	2.05E+02	1.03E+01	2.08E+02	-	1.4	-	20.7	-	20.7
Ni-63	3.20E+03	1.60E+03	6.40E+03	9.48E+01	1.01E+00	5.55E+03	9.99E+03	7.11E+01	1.85E+00	3.80E+01	1.90E+00	9.48E+01	-	1.2	-	16.9	-	17.6
Nb-95	NA	NA	NA	6.81E+00	6.81E+00	1.11E+01	2.50E+01	1.94E+01	5.04E-01			6.81E+00	-	NA	-	NA	NA	NA
Pu-238	6.70E+00	3.10E+00	1.20E+01	2.97E+00	7.31E-03	1.60E+01	2.91E+01	3.64E-01	1.04E-02	1.75E+00	8.76E-02	2.97E+00	+		-	1.0	-	1.1
Pu-239	2.50E+00	2.50E+00	1.00E+01	2.59E+00	6.09E-03	1.40E+01	2.54E+01	3.53E-01	1.01E-02	1.56E+00	7.80E-02	2.59E+00	+		+		+	
Pu-240	2.60E+00	2.50E+00	1.00E+01	2.60E+00	6.10E-03	1.41E+01	2.56E+01	3.53E-01	1.01E-02	1.56E+00	7.81E-02	2.60E+00	+		+		+	
Pu-241	5.60E+02	4.80E+00	1.70E+01	4.06E+02	1.05E+00	1.69E+03	3.06E+03	2.71E+01	7.74E-01	1.00E+01	5.02E-01	4.06E+02	+		+		+	
Pu-242	2.70E+00	2.70E+00	1.10E+01	2.73E+00	6.42E-03	1.48E+01	2.69E+01	3.72E-01	1.07E-02	1.56E+00	7.80E-02	2.73E+00	+		+		+	
K-40	5.70E-02	5.70E-02	2.90E-01	1.08E-01	4.45E-02	2.73E-01	6.15E-01	1.93E+00	5.14E-02			1.08E-01	-	1.1	+		+	
Ra-226 +D	5.50E-03	5.20E-03	2.70E-02	1.24E-02	6.32E-04	2.58E-02	5.79E-02	8.16E-04	3.42E-03	3.22E-01	1.61E-02	1.24E-02	-	1.0	+		+	
Ru-106+D	6.90E+29	1.90E+00	8.10E+00	2.25E+00	1.72E-01	3.89E+00	8.74E+00	1.13E+00	2.89E-02	6.43E+01	3.22E+00	2.25E+00	-	2.1	+		+	411.9

Table A-2. (continued).

Isotope	Risk Based Concentration from Fromm (1996)			Preliminary Remediation Goals (PRG)						Soil to Groundwater		EPA PRG for Residential Soil Decayed to 2095 (pCi/g)	EPA PRG is greater (+) or less (-) than old? How many times less?					
	Future Resident (pCi/g)	Current Resident (pCi/g)	Current Worker (pCi/g)	Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/gL)	Fish Ingestion (pCi/g)	DAF=20 (pCi/g)	DAF=1 (pCi/g)		Current Worker		Current Resident		Future 2095 Resident	
Sb-125+D	1.40E+10	2.50E-01	1.10E+00	4.62E-01	4.60E-01	7.56E-01	1.70E+00	9.28E+00	2.45E-01			4.62E-01	-	1.5	+		+	5.0
Sr-90+D	2.30E+02	2.10E+01	7.80E+01	2.31E-01	1.39E-03	1.08E+01	2.27E+01	6.44E-01	1.85E-02	2.69E-01	1.34E-02	2.31E-01	-	7.2	-	90.9	-	116.7
Tc-99	5.70E+02	5.70E+02	2.30E+03	2.50E-01	5.57E-03	8.96E+02	1.73E+03	1.73E+01	4.41E-01	3.73E+00	1.86E-01	2.50E-01	-	2.6	-	2280.0	-	2279.3
Th-228+D	2.20E+15	5.50E-01	2.40E+00	1.54E-01	3.38E-02	2.55E-01	5.73E-01	1.59E-01	4.18E-03	6.60E+01	3.30E+00	1.54E-01	-	9.4	-	3.6	-	93.4
Th-230	2.10E+01	2.10E+01	8.50E+01	3.49E+00	1.05E-02	2.02E+01	3.72E+01	5.23E-01	1.48E-02	6.06E+00	3.03E-01	3.49E+00	-	4.2	-	6.0	-	6.0
Th-232	2.40E+01	2.40E+01	9.80E+01	3.10E+00	9.42E-03	1.90E+01	3.48E+01	4.71E-01	1.33E-02	6.06E+00	3.03E-01	3.10E+00	-	5.2	-	7.7	-	7.7
U-232	3.00E+01	1.10E+01	4.50E+01	1.25E+00	5.59E-04	7.92E+00	1.43E+01	1.63E-01	4.58E-03	8.86E+06	4.43E+05	1.25E+00	-	5.7	-	8.8	-	10.1
U-233	NA	NA	NA	3.86E+00	1.84E-03	2.87E+01	5.34E+01	6.63E-01	1.82E-02	3.47E+03	1.74E+02	3.86E+00	-	NA	-	NA	-	NA
U-234	1.80E+01	1.80E+01	7.20E+01	4.01E+00	1.87E-03	3.24E+01	5.92E+01	6.74E-01	1.85E-02	2.24E+03	1.12E+02	4.01E+00	-	2.2	-	4.5	-	4.5
U-235+D	1.30E-01	1.30E-01	6.80E-01	1.95E-01	1.81E-03	3.98E-01	8.92E-01	6.63E-01	1.81E-02	7.77E-01	3.89E-02	1.95E-01	-	1.7	+		+	
U-236	1.90E+01	1.90E+01	7.60E+01	4.27E+00	1.98E-03	3.48E+01	6.33E+01	7.11E-01	1.95E-02	2.33E+01	1.16E+00	4.27E+00	-	2.2	-	4.4	-	4.4
U-238+D	6.70E-01	6.70E-01	3.40E+00	7.42E-01	1.47E-03	1.80E+00	4.00E+00	5.47E-01	1.46E-02	1.21E-01	6.04E-03	7.42E-01	-	1.9	+		+	
Zn-65	5.00E+44	1.40E+00	5.80E+00	1.18E+00	3.01E-03	2.01E+00	4.53E+00	4.07E+00	1.15E-01	5.60E+01	2.80E+00	1.18E+00	-	2.9	-		+	12562.4
Zr-93	1.50E+03	1.50E+03	6.10E+03	3.38E+02	2.00E+02	1.81E+03	3.26E+03	4.29E+01	1.22E+00			3.38E+02	-	3.4	-	4.4	-	4.4
Zr-95	NA	NA	NA	3.89E+00	3.89E+00	6.35E+00	1.43E+01	1.04E+01	2.68E-01			3.89E+00	NA	NA	NA	NA	NA	NA

Table A-3. Comparison of slope factors and RfDs used in the risk assessment to new values in IRIS.

COPCs	WAG	Contaminant Type	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	New Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Is new greater than or less than old?	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	New Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Is new greater than or less than old?	Oral RfD (mg/kg-day)	New Oral RfD (mg/kg-day)	Is new greater than or less than old?	Inhalation RfD (mg/kg-day)	New Inhalation RfD (mg/kg-day)	Is new greater than or less than old?	Comments
Acenaphthene	1	Organic		—		—	—		6.00E-02	6.00E-02[a]	Same		—		
Acetone	2	Organic	—	—		—	—		1.00E-01	9.00E-01[a]	Greater	—	—		
Acrylonitrile	2	Organic	5.40E-01	5.40E-01[a]	Same	5.70E-04	2.38E-01[a]	Greater	1.00E-03	1.00E-03[a]	Same	5.70E-04	5.71E-04	Same	
Anthracene	2	Organic		—		—	—		3.00E-01	3.00E-01[a]	Same	—	—		
Aroclor 1242	5	Organic	4.00E-01	4.00E-01[a]o	Same	—	3.50E-01[a]	New	—	—		—	—		
Aroclor 1248	5	Organic	4.00E-01	4.00E-01[a]o	Same	—	3.50E-01[a]	New	—	—		—	—		
Aroclor 1254	4,5	Organic	4.00E-01	4.00E-01[a]o	Same	—	3.50E-01[a]	New	2.00E-05	2.00E-05[a]	Same	—	—		
Aroclor 1260	1,2,3	Organic	7.70E+00	4.00E-01[a]o	Less	—	3.50E-01[a]	New	—	—		—	—		
Aroclor 1260	4	Organic	4.00E-01	4.00E-01[a]o	Same	—	3.50E-01[a]	New	2.00E-05	—	used 1254	—	—		
Aroclor 1260[b]	5	Organic	4.00E-01	4.00E-01[a]o	Same	—	3.50E-01[a]	New	—	—		—	—		
Benzo[a]anthracene	1	Organic	7.30E-01	7.30E-01	Same	6.10E-01									
Benzo[a]anthracene	4	Organic	7.30E-01	7.30E-01	Same	3.10E-01									
Benzo[b]fluoranthene	1,2	Organic	7.30E-01	7.30E-01[a]	Same	6.10E-01	3.08E-01[a]	Less		—		—	—		
Benzo[b]fluoranthene	4	Organic	7.30E-01	7.30E-01[a]	Same	3.10E-01	3.08E-01[a]	Same		—		—	—		
Benzo[a]pyrene	1	Organic	7.30E+00	7.30E+00[a]	Same	6.00E+00	3.08E+00[a]	Less	—	—		—	—		
Benzo[a]pyrene	3	Organic	7.30E+00	7.30E+00[a]	Same	6.10E-01	3.08E+00[a]	Greater	—	—		—	—		
Benzo[g,h,i]perylene	4	Organic	7.30E-01	—	Less	3.10E-01	—	Less		—			—		Used benzo(a)pyrene values for screening
Bis(2-ethylhexyl)phthalate	2,5	Organic	1.40E-02	1.40E-02[a]	Same	—	—	Same	2.00E-02	2.00E-02[a]	Same	—	—		
Butyl Benzyl Phthlate	2	Organic	—	—		—	—	Same	2.00E-01	2.00E-01[a]	Same	—	—		
Carbon disulfide	2	Organic	—	—		—	—	Same	1.00E-01	1.00E-01[a]	Same	2.90E-03	2.00E-01	Greater	
Carbon tetrachloride	2	Organic	1.30E-01	1.30E-01[a]	Same	5.25E-02	5.25E-02[a]	Same	7.00E-04	7.00E-04[a]	Same	5.70E-04	—	Less	
Chloroaniline, p-	2	Organic	—	—		—	—	Same	4.00E-03	4.00E-03[a]	Same	—	—		
Chloroform	2	Organic	6.10E-03	6.10E-03[a]	Same	8.05E-02	8.05E-02[a]	Same	1.00E-02	1.00E-02[a]	Same	—	—		
Chrysene	2	Organic	7.30E-03	7.30E-03[a]	Same	—	3.08E-03[a]	New	—	—		—	—		
DDT	2	Organic	3.40E-01	3.40E-01[a]	Same	3.40E-01	3.40E-01[a]	Same	5.00E-04	5.00E-04[a]	Same	—	—		
Dibenzofuran	2	Organic	—	—		—	—		4.00E-03	4.00E-03[a]	Same	—	—		
Dibutyl Phthalate	2,4	Organic	—	—		—	—		1.00E-01	1.00E-01[a]	Same	—	—		
Dichlorobenzene, 1,4-	2,5	Organic	2.40E-02	2.40E-02[a]	Same	—	—		3.00E-02	—		2.30E-01	2.29E-01	Same	
Dichloroethylene, 1,1-	5	Organic	6.00E-01	6.00E-01[a]	Same	1.20E+00	1.75E-01[a]	Less	9.00E-03	5.00E-02[a]	Greater	—	5.71E-02	Less	
Dichlorodifluoromethane	1	Organic	—	—		—	—		2.00E-01	2.00E-01[a]	Same	5.71E-02	5.71E-02	Same	
Dichloroethylene, 1,2-cis-	1	Organic	—	—		—	—		9.00E-03	1.00E-02	Greater	—	—		
Dichloroethylene, 1,2-trans-	1	Organic	—	—		—	—		9.00E-03	2.00E-02[a]	Greater	—	—		
Dimethylphenol, 2,4-	2	Organic	—	—		—	—		2.00E-02	2.00E-02[a]	Same	—	—		
Dinitrotoluene, 2,4-	2	Organic	—	6.80E-01[a]	New	—	—		2.00E-03	2.00E-03[a]	Same	—	—		
Fluoranthene	2	Organic	—	—		—	—		4.00E-02	4.00E-02[a]	Same	—	—		
Fluorene	2	Organic	—	—		—	—		4.00E-02	4.00E-02[a]	Same	—	—		
Indeno[1,2,3-cd]pyrene	2	Organic	7.30E-01	7.30E-01[a]	Same	—	3.08E-01[a]	New	—	—		—	—		

Table A-3. (continued).

COPCs	WAG	Contaminant Type	Oral Slope Factor (mg/kg-day)$^{-1}$	New Oral Slope Factor (mg/kg-day)$^{-1}$	Is new greater than or less than old?	Inhalation Slope Factor (mg/kg-day)$^{-1}$	New Inhalation Slope Factor (mg/kg-day)$^{-1}$	Is new greater than or less than old?	Oral RfD (mg/kg-day)	New Oral RfD (mg/kg-day)	Is new greater than or less than old?	Inhalation RfD (mg/kg-day)	New Inhalation RfD (mg/kg-day)	Is new greater than or less than old?	Comments
Isophorone	2	Organic	9.50E-04	9.50E-04[a]	Same	—	—		2.00E-02	2.00E-01[a]	Same	—	—		
Octyl Phthalate, di-N-	1,2	Organic	—	—		—	—		2.00E-02	4.00E-02	Greater	—	—		
Chlordecone (Kepone)	3	Organic	—	8.00E+00	New	—	—		—	2.00E-04	New	—	—		
Methylene chloride	2	Organic	7.50E-03	7.50E-03[a]	Same	1.64E-03	1.65E-03[a]	Same	6.00E-02	6.00E-02[a]	Same	8.60E-01	8.57E-01	Same	
Methylphenol, 4	2	Organic		—		—	—		—	—		—	—		
Naphthalene, 2-Methyl	2	Organic	—	—		—	—		—	4.00E-03[a]	New	—	—		
Naphthalene	1,2	Organic	—	—		—	—		4.00E-02	2.00E-02[a]	Less	—	8.57E-04	New	
Nitrobenzene	2	Organic	—	—		—	—		5.00E-04	5.00E-04[a]	Same	5.71E-04	5.71E-04	Same	
Nitrophenol, 2	2	Organic	—	—		—	—		—	—		—	—		
Phenanthrene	2,3,5	Organic	—	—		—	—		—	—		—	—		
Phenanthrene	4	Organic	—	—		—	—		4.00E-03	—	?	—	—		
Phenol	2	Organic	—	—		—	—		6.00E-01	3.00E-01[a]	Less	—	—		
Pyrene	2	Organic	—	—		—	—		3.00E-02	3.00E-02[a]	Same	—	—		
Tetrachloroethane, 1,1,2,2-	2	Organic	2.00E-01	2.00E-01[a]	Same	2.00E-01	2.03E-01[a]	Same	—	6.00E-02	New	—	—		
Tetrachloroethylene	1,2,5	Organic	5.20E-02	5.20E-02[a]	Same	2.00E-03	2.03E-03[a]	Same	1.00E-02	1.00E-02[a]	Same	1.00E-02	1.71E-01		WAGs 2 and 5 did not present an RfD for inhalation
Tetrahydrofuran	2	Organic	—	—		—	—		—	—		—	—		
Toluene	2	Organic	—	—		—	—		2.00E-01	2.00E-01[a]	Same	—	1.14E-01	New	
Toluene	2	Organic	—	—		—	—		2.00E-01	2.00E-01[a]	Same	—	1.14E-01	New	
Trichloroethane, 1,1,1-	2	Organic	—	—		—	—		9.00E-02	2.00E-01[a]	Greater	2.90E-01	6.29E-01	Greater	
Xylene, Mixture	2	Organic	—	—		—	—		2.00E+00	2.00E-01[a]	Less	—	2.86E-02	New	
Aluminum	3	Inorganic	—	—		—	—		1.00E+00	1.00E+00	Same	—	1.43E-03	New	
Antimony (metallic)	2,5	Inorganic	—	—		—	—		4.00E-04	4.00E-04[a]	Same	—	—		
Arsenic, Inorganic	1	Inorganic	1.50E+00	1.50E+00[a]	Same	5.00E+01	1.51E+01[a]	Less	3.00E-04	3.00E-04[a]	Same	—	—		
Arsenic, Inorganic		Inorganic	1.75E+00	1.50E+00[a]	Less	1.50E+00	1.51E+01[a]	Greater	3.00E-04	3.00E-04[a]	Same	—	—		
Arsenic, Inorganic	3	Inorganic	1.50E+00	1.50E+00[a]	Same	1.50E+00	1.51E+01[a]	Greater	3.00E-04	3.00E-04[a]	Same	—	—		
Arsenic, Inorganic	4	Inorganic	1.50E+00	1.50E+00[a]	Same	1.50E+02	1.51E+01[a]	Less	3.00E-04	3.00E-04[a]	Same	—	—		
Arsenic, Inorganic	5	Inorganic	1.80E+00	1.50E+00[a]	Less	1.50E+01	1.51E+01[a]	Same	3.00E-04	3.00E-04[a]	Same	—	—	New	
Barium	1,2,3,5	Inorganic	—	—		—	—		7.00E-02	7.00E-02[a]	Same	1.43E-04	1.43E-04		
Beryllium and compounds	2	Inorganic	4.30E+00	4.30E+00[a]	Same	8.40E+00	8.40E+00[a]	Same	5.00E-03	2.00E-03[a]	Less	—	5.71E-06		
Cadmium (Diet)	2	Inorganic	—	—		6.30E+00	6.30E+00[a]	Same	5.00E-04	1.00E-03[a]	Greater	—	—		
Cadmium (Diet)	3	Inorganic	—	—		6.30E+00	6.30E+00[a]	Same	1.00E-03	1.00E-03[a]	Same	—	—		
Cadmium (Diet)	5	Inorganic	—	—		1.80E-03	6.30E+00[a]	Greater	5.00E-04	1.00E-03[a]	Greater	—	—		
Cadmium (Water)		Inorganic	—	—			6.30E+00[a]	Same		5.00E-04[a]	Same	—	—		Used cadmium for water for screening
Chloride	2,3,5	Inorganic	—	—		—	—			—	+		—		
Chromium (III) (Insoluble Salts)	1,2,3	Inorganic	—	—			—			1.50E+00[a]	+	—	—		
Chromium (III) (Insoluble Salts)	5	Inorganic	—	—		—1.2E-02	—	Less	1.00E+00	1.50E+00[a]	Greater	—	—		
Chromium VI (particulates)	5	Inorganic	—	—		1.20E-02	4.20E+01[a]	Greater	5.00E-03	3.00E-03[a]	Less	—	2.86E-05	New	
Chromium VI (particulates)	2	Inorganic	—	—		2.90E+02	4.20E+01[a]	Less	5.00E-03	3.00E-03[a]	Less	—	2.86E-05	New	

Table A-3. (continued).

COPCs	WAG	Contaminant Type	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	New Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Is new greater than or less than old?	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	New Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Is new greater than or less than old?	Oral RfD (mg/kg-day)	New Oral RfD (mg/kg-day)	Is new greater than or less than old?	Inhalation RfD (mg/kg-day)	New Inhalation RfD (mg/kg-day)	Is new greater than or less than old?	Comments
Cobalt	2,5	Inorganic	—	—		—	9.80E+00[a]	New	6.00E-02	2.00E-02	Less	2.90E-04	5.71E-06	Less	
Copper	2,5	Inorganic	—	—		—	—		3.70E-02	4.00E-02[a]	Less	—	—		
Fluoride	2	Inorganic	—	—		—	—		6.00E-02	—	Less	—	—		
Lead And Compounds	2,3,4,5	Inorganic	—	—		—	—		--	—	-		—		
Manganese (Diet)	1,2,3,5	Inorganic	—	—		—	—		1.40E-01	1.40E-01[a]	Same	1.40E-05	1.43E-05	Same	
Manganese (Water)	1,2,3	Inorganic		—			—		5.00E-03	4.60E-02[a]	Greater	1.40E-05	1.43E-05		
Mercury, Inorganic Salts	1,3,5	Inorganic	—	—		—	—		3.00E-04	3.00E-04[a]	Same	8.57E-04	—		Conservatively used elemental value for inhalation
Mercury, Inorganic Salts	4	Inorganic	—	—		—	—		3.00E-04	3.00E-04[a]	Same	8.57E-05	—		Conservatively used elemental value for inhalation
Nickel Soluble Salts	5	Inorganic		—			—		2.00E-02	2.00E-02[a]	Same	—	—		
Nitrate	2,3	Inorganic	—	—		—	—		1.60E+00	1.60E+00[a]	Same	—	—		
Nitrite	2	Inorganic	—	—		—	—		1.00E-01	1.00E-01[a]	Same	—	—		
Osmium	3	Inorganic	—	—		—	—		—	—		—	—		
Orthophosphate	2	Inorganic	—	—		—	—		—	—		—	—		
Selenium	2,5	Inorganic	—	—		—	—		5.00E-03	5.00E-03[a]	Same	—	—		
Silver	2,5	Inorganic	—	—		—	—		5.00E-03	5.00E-03[a]	Same	—	—		
Strontium, Stable	2	Inorganic	—	—		—	—		6.00E-01	6.00E-01[a]	Same	—	—		
Sulfate	2,3	Inorganic	—	—		—	—		—	—		—	—		
Sulfide	2	Inorganic	—	—		—	—		—	—		—	—		
Thallium (Soluble Salts)	2,3	Inorganic	—	—		—	—		—	—		—	—		
Thallium (Soluble Salts)	5	Inorganic	7.00E-05	—	Same	—	—		—	—		—	—		
Tin	2	Inorganic		—			—		6.00E-01	6.00E-01[a]	Same		—		
Uranium (Soluble Salts)	1,3	Inorganic	—	—		—	—		3.00E-03	6.00E-04[a]	Less	—	—		
Vanadium, Metallic	2,5	Inorganic	—	—		—	—		7.00E-03	7.00E-03[a]	Same	—	—		
Zinc (Metallic)	2,5	Inorganic	—	—		—	—		3.00E-01	3.00E-01[a]	Same	—	—		

a. Footnote information is found in HEAST (EPA 1995).
b. Aroclor-1260 was sampled for, but not detected at WAG 5.

Table A-4. Evaluation in changes in total risk due to changes in inhalation slope factors.

	Group 1						Group 2		Group 3		Group 5	Group 6	
	ARA-01	**ARA-02 Soils**	**ARA-02 Seepage Pit**	**ARA-03**	**ARA-16**	**ARA-23**	**ARA-12**	**ARA-24**	**PBF-10**	**PBF-12**	**PBF-21**	**PBF-22**	**PBF-26**
Inhalation risk	2.E-08	2.E-08	2.E-08	2.E-08	2.E-08	2.E-08	2.E-06	2.E-06	3.E-18	3.E-18	2.E-17	2.E-07	2.E-07
Total risk	8.E-04	4.E-04	2.E-03	2.E-05	4.E-04	1.E-04	2.E-03	2.E-06	2.E-05	2.E-05	1.E-05	2.E-04	3.E-04
Percent of total	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	100.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Original Results													
Aroclor-1242	NTD	NTD	NTD	NTD	NTD	NTD	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254[a]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.E-09	5.E-09
Arsenic	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	NA	NA	NA	NA	NA	2.E-07	2.E-07
Cadmium[b]	NTD	NTD	NTD	NTD	NTD	NTD	NA	NA	NA	NA	NA	NA	NA
Chromium-III	9.E-10	9.E-10	9.E-10	9.E-10	9.E-10	9.E-10	2.E-07	2.E-07	NA	NA	NA	NA	NA
Chromium-VI	6.E-09	6.E-09	6.E-09	6.E-09	6.E-09	6.E-09	1.E-06	1.E-06	NA	NA	NA	NA	NA
Thallium[c]	5.E-09	5.E-09	5.E-09	5.E-09	5.E-09	5.E-09	NA	NA	NA	NA	NA	NA	NA
Sum	2.E-08	2.E-08	2.E-08	2.E-08	2.E-08	2.E-08	1.E-06	1.E-06	0.E+00	0.E+00	0.E+00	2.E-07	2.E-07
Recalculated													
Aroclor-1242	4.E-13	4.E-13	4.E-13	4.E-13	4.E-13	4.E-13	NA	NA	NA	NA	NA	NA	NA
Aroclor-1254	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.E-09	5.E-09
Arsenic	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	NA	NA	NA	NA	NA	2.E-07	2.E-07
Cadmium	6.E-11	6.E-11	6.E-11	6.E-11	6.E-11	6.E-11	NA	NA	NA	NA	NA	NA	NA
Chromium III	NTD	NTD	NTD	NTD	NTD	NTD	NTD	NTD	NA	NA	NA	NA	NA
Chromium VI	5.E-11	5.E-11	5.E-11	5.E-11	5.E-11	5.E-11	1.E-08	1.E-08	NA	NA	NA	NA	NA
Thallium	NTD	NTD	NTD	NTD	NTD	NTD	NA	NA	NA	NA	NA	NA	NA
Sum	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	8.E-09	1.E-08	1.E-08	0.E+00	0.E+00	0.E+00	2.E-07	2.E-07

a. Although the aroclor-1254 slope factor for inhalation was not presented, it was calculated in Table B-85 of DOE-ID(1999). It appears that the currently accepted value (.35 1/(mg/kg-day) was used.
b. Although a cadmium slope factor was presented, it was not calculated.
c. Although a thallium slope factor for inhalation is not presented in Table B-20 of DOE-ID (1999), the ingestion slope factor was used.
Group 3 risk from inhalation is due to radionuclides (see DOE-ID 1995, Table B-85)

NTD = no toxicity data
NA= not applicable (COPC not detected at site)

Appendix B

Activities Completed since September 30, 2004

Waste Area Group 1

Since September 30, 2004, the following activities have been performed at Waste Area Group (WAG) 1:

TSF-26 – PM-2A

- Shipped PM2A Tanks V-13 and V-14 to the Idaho CERCLA Disposal Facility (ICDF)
- Disposed of Tank V-13 at the ICDF
- Designed and constructed Tank V-14 contents treatment process
- Treated Tank V-14 contents.

TSF-09/18 – V-Tanks (V-1, V-2, V-3 and V-9)

- Excavated the soil to the top of the V-tanks
- Removed and disposed of ancillary piping
- Constructed the waste transfer and treatment system
- Removed the waste from Tanks V-1, V-2, and V-3 to the treatment/consolidation tanks
- Began treatment of the consolidated V-tanks waste
- Disposed of the caustic tank (V-4)
- Disposed of the V-tanks sand filter.

Operable Unit (OU) 1-07B Remedial Action Reports

The following interim remedial action reports have been completed since September 30, 2004:

- *In Situ Bioremediation Interim Remedial Action Report, Test Area North, Operable Unit 1-07B*, DOE/ND-ID-11221, Rev. 1, June 2005
- *Monitored Natural Attenuation Interim Remedial Action Report, Test Area North, Operable Unit 1-07B*, DOE/NE-ID-11229, Rev. 0, August 2005

Waste Area Group 2

Since September 30, 2004, the following activities have been performed at WAG 2:

- Completed two new perched water monitoring wells (TRA-1933 and TRA-1934)
- Installed petro traps in Wells TRA-1933, TRA-1934, and PW-13 to collect free-phase diesel product
- Initiated monthly monitoring in November 2004 for the presence and thickness of free product in Wells TRA-1933, TRA-1934, and PW-13.

(A detailed discussion of the petro trap monitoring and interface probe monitoring is presented in the *Annual Groundwater Monitoring Status Report for Waste Area Group 2 for Fiscal Year 2005*, [ICP/EXT-05-00967].)

Waste Area Group 3

Since September 30, 2004, the following activities have been performed at WAG 3:

Implementation of Phase I of OU 3-13, Group 3, Other Surface Soils Remediation Sets 1–3, began in accordance with the *Operable Unit 3-13, Group 3, Other Surface Soils Remediation Sets 1-3 (Phase I) Remedial Design/Remedial Action Work Plan* (DOE/ID-11089). The status includes the following:

- Completed remedial actions at Site CPP-67
- Prepared the *Site Completion Report for Area CPP-67, WAG 3, OU 3-13, Group 3 Other Surface Soil* (DOE/NE-ID-11234)
- Initiated remediation at Sites CPP-34A and CPP-34B, including the following:
  - Collection of confirmation samples for ICDF approval process
  - Excavation and hauling of contaminated soil to the ICDF
  - Collection of verification samples
  - Backfilling of the excavation with clean dirt
  - Cleanup (activities are currently ongoing and expected to be complete by the end of the 2005 construction season)
- Completed characterization activities to support waste profile development for CPP-92, -97, -98, and -99. This waste is planned for disposal at the ICDF.

Additional activities planned for the 2005 construction season include the following:

- Collection of characterization samples for Sites CPP-34b and -34c
- Initiation of remedial actions at Sites CPP-92, -97, -98, and -99.

The remaining Group 3 sites will be included in Phase II.

Note: Site CPP-81 consists of a vent off-gas pipe from Building 637 at the Idaho Nuclear Technology and Engineering Center. The OU 3-13 record of decision (ROD) signed in October 1999 stated that there was insufficient information to make a decision on Site CPP-81, and that it should be included for further evaluation under OU 3-13. The explanation of significant differences (ESD) to the OU 3-13 ROD signed in January 2004 assessed previous decontamination efforts for this pipe, including five nitric acid flushes, 14 water rinses, and subsequent rinsate sampling and camera inspection. Based on this information, the ESD determined that the site qualified as a no-action site due to the previous decontamination efforts. However, during D&D activities at Building 637 in 2005, the pipe was cut and residual waste was discovered, bringing into question the no-action classification assigned in the ESD. Consequently, the U.S. Environmental Protection Agency and the Idaho Department of Environmental Quality have requested that this site be evaluated as a Group 3 site under the 3-13 ROD.

Waste Area Group 4

Since September 30, 2004, the following activities have been performed at WAG 4:

- Installation of two aquifer water monitoring wells (CFA-1931 and -1932), which were also equipped with vapor ports
- Repair of the subsidence at CFA Landfill III and reporting of the repair in the *INL Sitewide Operations and Maintenance Report for CERCLA Response Actions—FY 2005* (DOE/ID-11249).

Waste Area Group 5

Since September 30, 2004, the following activities have been performed at WAG 5:

- Completed the *Remedial Action Report for the Operable Unit 5-12 Remedial Action* (DOE/NE-ID-11205)
- Completed the *Operations and Maintenance Report for Operable Unit 5-12* (DOE/NE-ID-11228)
- Completed decontamination and decommissioning activities pertaining to the Power Burst Facility reactor complex (PER-620) in accordance with the requirements delineated in the *Engineering Evaluation/Cost Analysis for Phase 1 of the Decommissioning for the Power Burst Facility Reactor Building (PER-620)* (DOE/NE-ID-11196); Phase I activities completed under a time-critical removal action include the following:
    - Removal and dispositioning of low-level radioactive liquids from PER-620
    - Removal and dispositioning of liquids in the PER-706 evaporation tank
    - Removal and dispositioning of most of the shielding lead and all cadmium sheeting
    - Removal and dispositioning of the in-pile tube
    - Installation of shielding over the reactor after removal of the reactor vessel water
    - Removal and disposing of some radioactive hot spots to reduce worker exposures during removal of shielding lead
    - Isolation of utility lines and other piping to the Power Burst Facility reactor building and weatherproofing it
    - Managing and disposing of other waste generated incidental to accomplishing this scope as CERCLA waste.

Waste Area Group 6

No additional remedial activities have been conducted at WAG 6 since September 30, 2004.

Waste Area Group 7

No additional remedial activities have been conducted at WAG 7 since September 30, 2004.

Waste Area Group 9

No additional remedial activities have been conducted at WAG 9 since September 30, 2004.

Waste Area Group 10

No additional remedial activities have been conducted at WAG 10 since September 30, 2004.